



United States
Department of
Agriculture

Soil
Conservation
Service

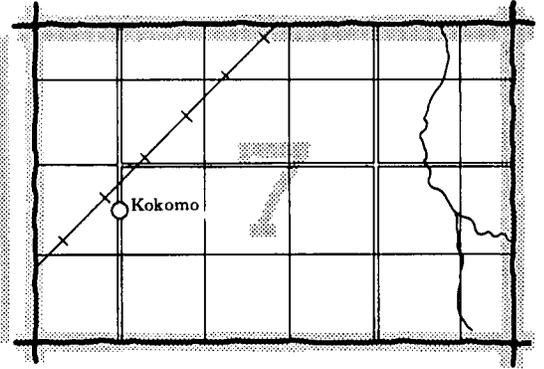
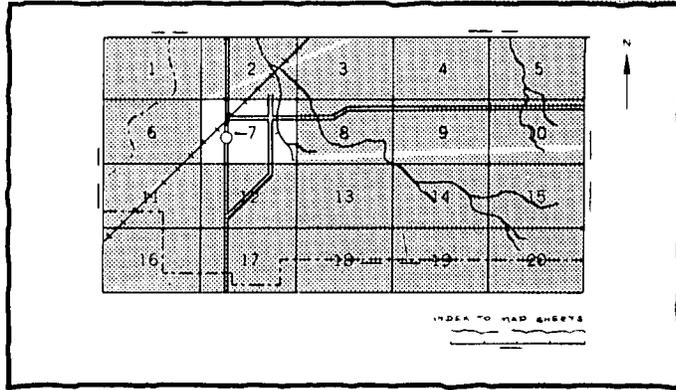
In Cooperation with
United States
Department of the
Interior, Bureau
of Land Management;
and the New Mexico
Agricultural
Experiment Station

Soil Survey of Chaves County New Mexico Northern Part



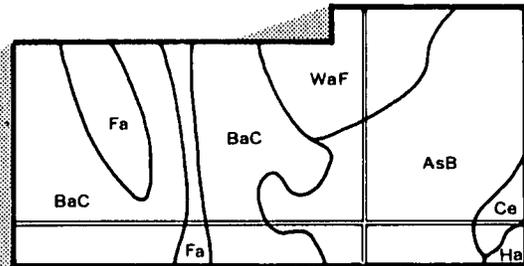
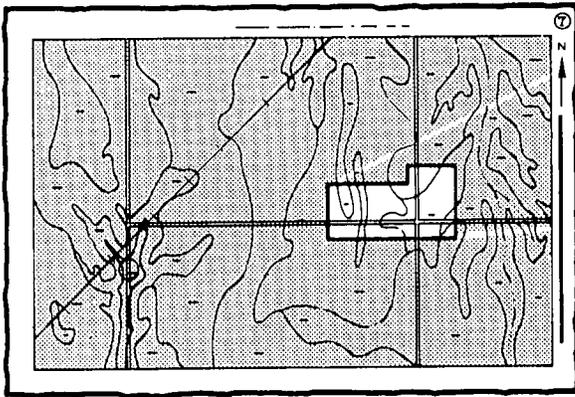
HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

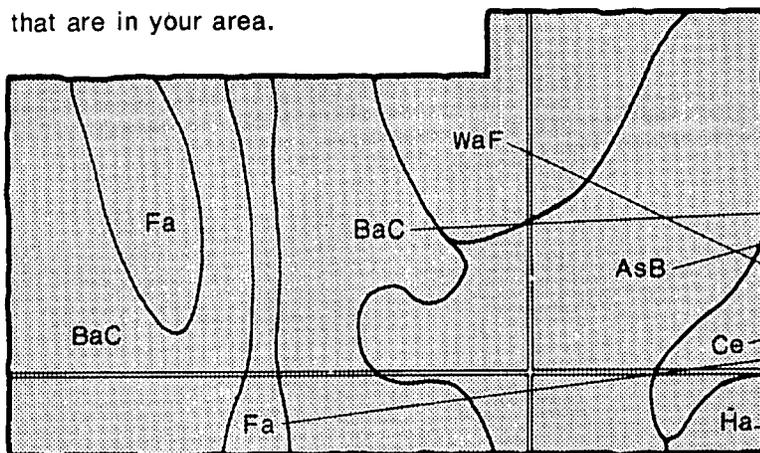


2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



4. List the map unit symbols that are in your area.

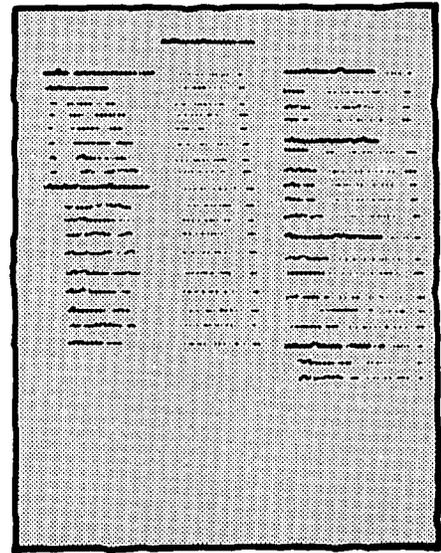
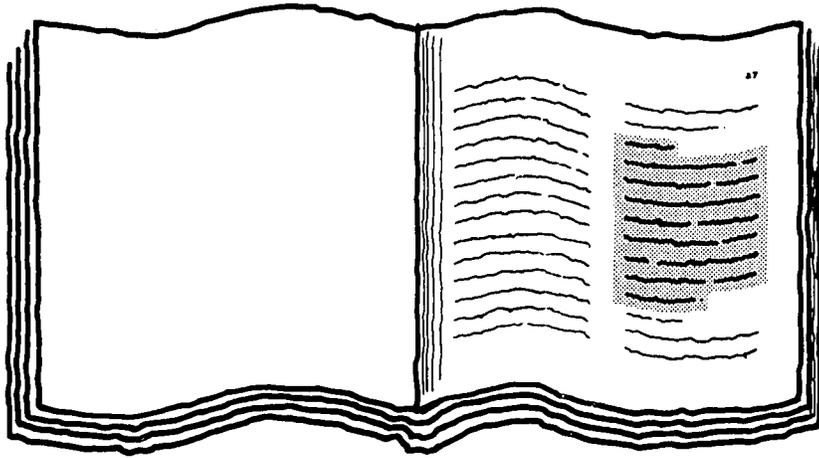


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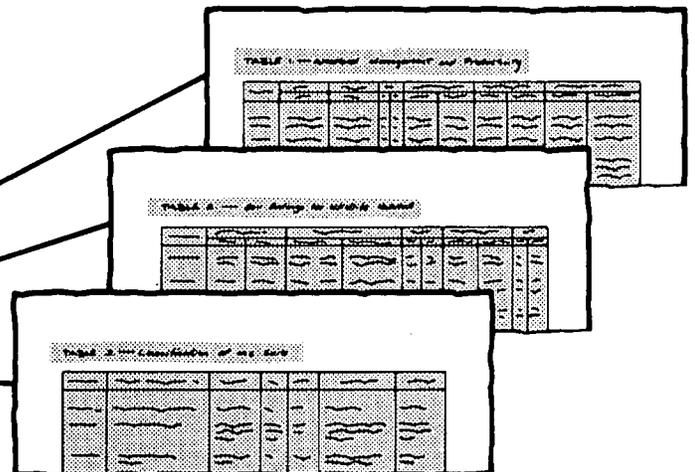
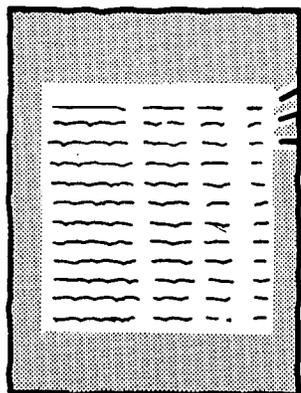
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THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

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 Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was performed in the period 1975-80. Soil names and descriptions were approved in 1980. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1980. This survey was made cooperatively by the Soil Conservation Service, the Bureau of Land Management, and the New Mexico Agricultural Experiment Station. It is part of the technical assistance furnished to the Chaves and Border Soil and Water Conservation Districts.

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

Cover: Corn on Glendale silt loam.

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Foreword

This soil survey contains information that can be used in land-planning programs in Chaves County, New Mexico, Northern Part. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

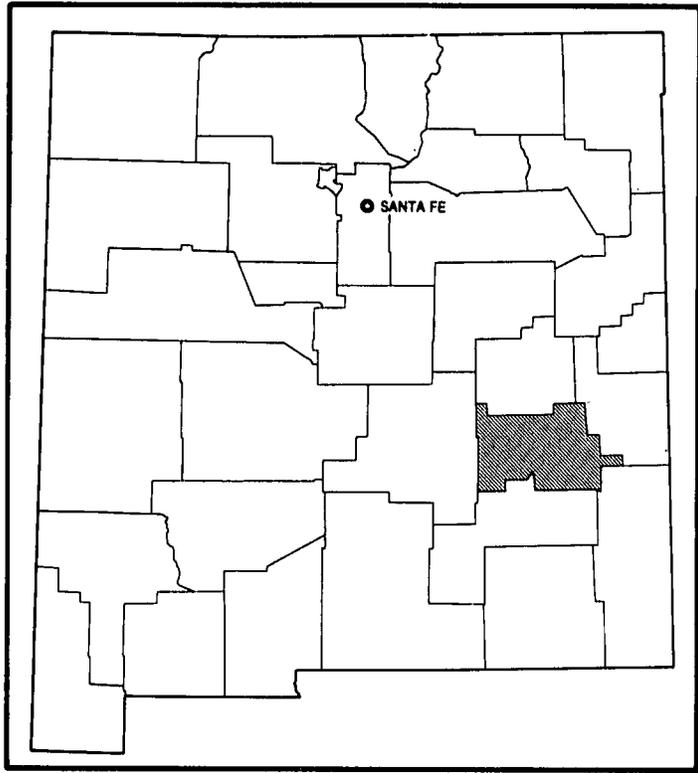
This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure 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.

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 Soil Conservation Service or the Cooperative Extension Service.



Ray T. Margo, Jr.
State Conservationist
Soil Conservation Service



Location of Chaves County, New Mexico, Northern Part.

Soil Survey of Chaves County, New Mexico Northern Part

By Charles D. Lenfesty, Soil Conservation Service

Fieldwork by Charles D. Lenfesty, Richard A. Bird, Robert C. Dancker, Letticia Faust, John Nordin, and Rebecca A. Stein,
Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service,
in cooperation with the United States Department of the Interior,
Bureau of Land Management, and the
New Mexico Agricultural Experiment Station

CHAVES COUNTY, NEW MEXICO, NORTHERN PART is in the southeastern part of New Mexico. The survey area has a total area of 1,851,233 acres, or about 2,893 square miles. There is no major community in the area. Roswell, the county seat of Chaves County, is outside the survey area but serves as a commerce center for the area. No schools are within the area. Three highways— U.S. 70, 285, and 380— and the Atchison, Topeka, and Santa Fe Railroad traverse the area.

The survey area is dissected by the Pecos River, which flows from north to south. The part of the Pecos Valley in or near the area ranges in elevation from about 4,300 feet at the De Baca County line in the north to nearly 3,600 feet at Roswell. The terrain rises gradually both east and west of the Pecos River, reaching approximately 4,300 feet at the Roosevelt and Lea County lines to the east. A number of arroyos approach the valley from the west. The main ones are Salt Creek, Padilla Creek, and Macho Draw. A few smaller arroyos approach from the east. An isolated peak in the northeast corner of the area rises to 4,754 feet.

The survey area is principally agricultural land, and most of it is used for livestock enterprises, mainly livestock grazing. Oilfields and gasfields are in production in the central part of the area, and exploration for these products continues.

About 10,000 acres in the area, mostly in the south-central part, is irrigated cropland. The principal crops are alfalfa, cotton, grain sorghum, and small grain. Irrigated pasture is also important.

The survey area is served by the Chaves and Border Soil and Water Conservation Districts. The districts were organized so that farmers and ranchers could effectively control water erosion and soil blowing, avoid overgrazing of grassland, and prevent the invasion of brush and noxious weeds. The farmers and ranchers also recognized the need for increasing the number of watering places for livestock and for conserving irrigation water.

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

Climate

By Frank E. Houghton, climatologist for New Mexico, National Weather Service, U.S. Department of Commerce.

The average annual precipitation in the survey area is approximately 12 inches. It ranges from about 11 inches at the lower elevations in the Pecos Valley to about 13 inches along the west county line and to about 14 inches in the extreme eastern part of the area. The total annual precipitation generally increases with elevation. Table 1 shows the distribution of precipitation at Roswell, New Mexico, which generally is representative of the survey

area. An average of 4 to 6 days a year may be expected to have 0.5 inch or more of precipitation, and 0.1 inch or more is likely on 20 to 30 days.

The season for snowfall is November through April; the winter months receive the greatest totals. An annual average of approximately 10 inches of snowfall can be expected in the area, but seasonal totals vary from 2 to 31 inches at Roswell. Although 15.3 inches of snow fell at Roswell in 24 hours on December 8 and 9, 1960, usually only 1 or 2 inches falls in a day and does not stay long on the ground.

The average annual temperature in the survey area is about 58 degrees F. It ranges from about 56 degrees along the western border to about 60 degrees in the south-central valley and in the northern part of the area. The average annual daily high temperature in the area is about 75 degrees, and the average annual daily low temperature is about 41 degrees. Table 1 shows the average monthly high and low temperatures at Roswell. The highest temperature recorded was 112 degrees on July 14, 1958, at Bitter Lakes Wildlife Refuge, and the lowest was 29 degrees below zero on February 13, 1905, at Roswell. An annual average of as many as 125 days with maximum temperatures of 90 degrees F or greater occurs at the lower elevations of the Pecos Valley, but the higher elevations in the area have an average of about 75 days. Minimum temperatures of 32 degrees or lower occur on an average of about 110 to 125 days annually. The average length of the growing season, the period between the last temperature of 32 degrees or lower in spring and the first temperature of 32 degrees or lower in fall, is 208 days at Roswell.

The average annual relative humidity in the survey area, as typified by measurements made at Roswell, is about 50 percent. Early in the morning humidity averages about 70 percent, and by afternoon it averages about 30 percent. The lowest average humidity occurs in spring, with morning highs of about 55 percent and afternoon lows of about 20 percent. Humidity is highest late in summer and early in fall, during the rainy season, at which time it ranges from about 75 percent early in the morning to about 35 percent in the afternoon.

Evaporation from a Class A evaporation pan at Bitter Lakes Wildlife Refuge averages 96 inches a year, two-thirds of which occurs during May through October. Evaporation amounts within 9 inches of this average can be expected to occur during at least two-thirds of the years. These values generally are representative of the northern part of Chaves County.

Annual average windspeed at Roswell Airport is about 10 miles per hour. Average windspeed is greatest, about 12 miles per hour, in spring and during the month of June. It is about 8 to 9 miles per hour in other months. During nearly 40 percent of the hours, the wind is from the southeast. The strongest winds, those above 24 miles per hour, occur with greatest frequency from westerly directions. On the average, easterly winds are

the lightest and westerly winds are the strongest. The general north-south orientation of the Pecos Valley at Roswell probably increases the frequency of wind in those directions to values higher than those in localities at a greater distance from the river. Areas outside the valley probably receive windflow from the westerly direction more often than does Roswell.

Sunshine occurs about three-fourths of the possible hours in the survey area, or an average of nearly 3,300 hours annually. An average of 185 days a year are clear, and 180 days are cloudy.

An average of 41 thunderstorms a year occur at Roswell, and this figure generally is representative of the survey area. Two-thirds of these occur in summer. Thunderstorms seldom occur in winter. Heavy fog occurs an average of 1 or 2 days a month from late in fall to early in spring.

Tornadoes have been reported mainly in the vicinity of Roswell. About seven tornadoes in 50 years have been reported in the area north of Roswell, and about six have been reported in the area south of Roswell. Damage usually has been light.

Hail occurs an average of twice a year in the Roswell area. The frequency of occurrence is greatest late in spring and early in summer, April through July. In some years (about 1 in 6) the area does not receive hail, but as many as eight hailstorms occurred in 1919. In a 14-year period, 1950-63, hailstones 0.75 inch in diameter or larger were noted during 12 hailstorms.

How This Survey Was Made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this

survey area are described under "General Soil Map Units" and "Detailed Soil Map Units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined

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

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland and woodland managers, engineers, planners, developers and builders, home buyers, and others.

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, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

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

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

The 13 map units in this survey have been grouped into four general kinds of landscape for broad interpretive purposes. Each of the broad groups and the map units in each group are described in the following pages.

Map Unit Descriptions

Soils on high plains, high terraces, and alluvial side slopes below landscape breaks

This group consists of five map units. It makes up about 56 percent of the survey area. The native vegetation is mainly grasses and shrubs. Elevation is 3,600 to 4,700 feet. The average annual precipitation is about 12 to 15 inches, the average annual air temperature is 59 to 60 degrees F, and the average frost-free season is 190 to 205 days.

The soils in this group formed in alluvial and eolian material.

This group is used mainly for livestock grazing. It is also used for wildlife habitat.

1. Faskin-Douro-Kimbrough

Shallow to deep, well drained, nearly level to rolling soils; on low ridges and in depressional areas on high plains

This map unit is in the extreme eastern part of the survey area. Slope is 0 to 15 percent. The vegetation on this unit is mainly grasses and shrubs. Elevation is 4,300

to 4,700 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 59 degrees F, and the average frost-free season is about 190 days.

This unit makes up about 3 percent of the survey area. It is about 35 percent Faskin soils, 22 percent Douro soils, and 19 percent Kimbrough soils. The remaining 24 percent is components of minor extent.

Faskin soils are in nearly level depressional areas on high plains. These soils are deep, well drained, and moderately permeable. They formed in alluvial and eolian deposits. The surface layer is yellowish brown fine sand about 14 inches thick. The subsoil is light reddish brown and brown sandy clay loam about 42 inches thick. The substratum to a depth of 60 inches or more is pinkish white loam.

Douro soils are in nearly level areas on low ridges of high plains. These soils are moderately deep, well drained, and moderately permeable. They formed in calcareous alluvial and eolian deposits. The surface layer is reddish brown loamy fine sand and fine sandy loam about 11 inches thick. The subsoil is yellowish red sandy clay loam about 22 inches thick. An indurated caliche hardpan is at a depth of 33 inches.

Kimbrough soils are in nearly level to rolling areas on low ridges of high plains. These soils are shallow, well drained, and moderately permeable. They formed in calcareous alluvium. The surface layer is brown gravelly fine sandy loam about 11 inches thick. An indurated caliche hardpan is at a depth of 11 inches.

Of minor extent in this unit are Portales; Ratliff, moist; Sharvana; and Slaughter soils.

This unit is used mainly for livestock grazing. It is also used for wildlife habitat. A hazard of soil blowing and shallow depth to indurated caliche are the main limitations for most uses. Overgrazing is an important concern of management because it increases the risk of soil blowing and results in an increase in undesirable plants.

This unit provides habitat for wildlife such as pronghorn antelope, coyote, black-tailed jackrabbit, spotted ground squirrel, black-tailed prairie dog, yellow-faced pocket gopher, silky pocket mouse, burrowing owl, scaled quail, horned lark, meadowlark, western spadefoot toad, Texas horned lizard, western coachwhip snake, and prairie rattlesnake. Where large woody plants are present, scissor-tailed flycatcher, mourning dove,

white-necked raven, mockingbird, western kingbird, ferruginous hawk, and Swainson's hawk nest. In areas of farmland, lesser sandhill crane and long-billed curlew feed or loaf during migration. Lark bunting is a regular winter migrant. Cranes and curlews use the playas interspersed throughout the unit. Plains toad and green toad are residents. In the playas, desert shrimp and annual freshwater clams hatch and spawn intermittently.

2. Nutivoll-Jalmar-Faskin

Deep, well drained and excessively drained, nearly level to rolling soils; on dunes and in interdunal and depressional areas on high plains

This map unit is in the eastern and northeastern parts of the survey area. Slope is 0 to 13 percent. The vegetation on this unit is mainly grasses and shrubs. Elevation is 4,100 to 4,500 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 59 degrees F, and the average frost-free season is about 190 days.

This unit makes up about 1 percent of the survey area. It is about 38 percent Nutivoli soils; 24 percent Jalmar soils; and 22 percent Faskin soils. The remaining 16 percent is components of minor extent.

Nutivoli soils are in gently sloping to rolling areas on dunes of high plains. These soils are deep, excessively drained, and rapidly permeable. They formed in eolian material. The surface layer is brown fine sand about 6 inches thick. Below this to a depth of 60 inches or more is red loamy fine sand and yellowish red loamy sand.

Jalmar soils are in nearly level interdunal areas on high plains. These soils are deep, well drained, and moderately permeable. They formed in alluvial and eolian deposits. The surface layer is brown, light brown, and reddish yellow fine sand about 34 inches thick. The subsoil to a depth of 60 inches or more is reddish yellow sandy clay loam.

Faskin soils are in nearly level depressional and interdunal areas on high plains. These soils are deep, well drained, and moderately permeable. They formed in alluvial and eolian deposits. The surface layer is yellowish brown fine sand and loamy fine sand about 14 inches thick. The subsoil is brown, light reddish brown, and pink sandy clay and fine sandy loam about 42 inches thick. The substratum to a depth of 60 inches or more is pinkish white loam.

Of minor extent in this unit are Douro soils.

This unit is used mainly for livestock grazing. It is also used for wildlife habitat. A hazard of soil blowing, a sandy surface layer, and droughtiness are the main limitations for most uses. Overgrazing is a major concern of management because it increases the risk of soil blowing and results in an increase in undesirable plants.

This unit provides habitat for wildlife such as pronghorn antelope, badger, swift fox, desert cottontail, spotted ground squirrel, hispid pocket mouse, Ord's kangaroo rat, northern grasshopper mouse, southern

plains woodrat, ferruginous hawk, roadrunner, scaled quail, meadowlark, ornate box turtle, lesser earless lizard, round-tailed horned lizard, bullsnake, and western diamondback rattlesnake. Where large woody plants are present, scissor-tailed flycatcher, mourning dove, white-necked raven, mockingbird, western kingbird, loggerhead shrike, roadrunner, ferruginous hawk, and Swainson's hawk nest. Rock wren and ferruginous hawk occasionally nest on dunes. Grasshopper and vesper sparrows use the unit during fall migration, and marsh hawks hunt over it during the cooler months.

3. Faskin-Roswell-Jalmar

Deep, well drained and excessively drained, nearly level to hilly soils; on high terraces

This map unit is in the eastern part of the survey area. Slope is 0 to 30 percent. The vegetation on this unit is mainly grasses and shrubs. Elevation is 3,800 to 4,200 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 60 degrees F, and the average frost-free season is about 200 days.

This unit makes up about 25 percent of the survey area. It is about 37 percent Faskin soils, 25 percent Roswell soils, and 14 percent Jalmar soils. The remaining 24 percent is components of minor extent.

Faskin soils are in nearly level areas on high terraces. These soils are deep, well drained, and moderately permeable. They formed in alluvial and eolian deposits. The surface layer is yellowish brown fine sand and loamy fine sand about 14 inches thick. The subsoil is brown, light reddish brown, and pink sandy clay loam about 42 inches thick. The substratum to a depth of 60 inches or more is pinkish white loam.

Roswell soils are in gently undulating to hilly areas of high terraces. These soils are deep, excessively drained, and rapidly permeable. They formed in eolian deposits. The surface layer is pale brown and light yellowish brown fine sand about 19 inches thick. The substratum to a depth of 60 inches or more is light brown fine sand.

Jalmar soils are in nearly level areas on high terraces. These soils are deep, well drained, and moderately permeable. They formed in alluvial and eolian deposits. The surface layer is brown, light brown, and reddish yellow fine sand about 34 inches thick. The subsoil to a depth of 60 inches or more is reddish yellow sandy clay loam.

Of minor extent in this unit are Chispa, Malstrom, Pyote, Stromal, and Tucumcari soils.

This unit is used mainly for livestock grazing. It is also used for wildlife habitat. A hazard of soil blowing, a sandy surface layer, and droughtiness are the main limitations for most uses. Overgrazing is an important concern of management because it increases the risk of soil blowing and promotes an increase in undesirable plants.

This unit provides habitat for wildlife such as pronghorn antelope, swift fox, badger, desert cottontail, spotted ground squirrel, plains pocket mouse, Ord's kangaroo rat, prairie falcon, lesser prairie chicken, burrowing owl, ornate box turtle, bullsnake, and little striped whiptail. Swainson's hawk and several species of smaller birds nest in areas of coppice dunes that support large woody shrubs. Populations of rodents and their predators are greater in these areas.

4. Redona-Ratliff-Blakeney

Shallow and deep, well drained, nearly level to gently sloping soils; on high terraces

This map unit is in the eastern part of the survey area. Slope is 0 to 5 percent. The vegetation on this unit is mainly grasses and shrubs. Elevation is 3,700 to 4,700 feet. The average annual precipitation is about 14 inches, the average annual air temperature is about 60 degrees F, and the average frost-free season is about 200 days.

This unit makes up about 20 percent of the survey area. It is about 27 percent Redona soils, 25 percent Ratliff soils, and 10 percent Blakeney soils. The remaining 38 percent is components of minor extent.

Redona soils are in nearly level areas on high terraces. These soils are deep, well drained, and moderately permeable. They formed in calcareous alluvium. The surface layer is reddish brown fine sandy loam about 12 inches thick. The subsoil is reddish brown and light reddish brown sandy clay loam about 48 inches thick.

Ratliff soils are in nearly level areas on high terraces. These soils are deep, well drained, and moderately permeable. They formed in calcareous alluvium. The surface layer is reddish brown fine sandy loam about 6 inches thick. The subsoil is reddish brown, light reddish brown, and white sandy clay loam about 54 inches thick.

Blakeney soils are in nearly level to gently sloping areas on high terraces. These soils are shallow, well drained, and moderately rapidly permeable. They formed in calcareous alluvial and eolian deposits. The surface layer is brown fine sandy loam about 2 inches thick. The subsoil is brown fine sandy loam about 11 inches thick. An indurated caliche hardpan is at a depth of 13 inches.

Of minor extent in this unit are Bascom, Canez, Gallegos, Ima, Latom, Philder, and Portales, dry, soils; Rock outcrop; Sharvana, dry, soils; Torriorthents; and Tucumcari soils.

This unit is used mainly for livestock grazing. It is also used for wildlife habitat. A hazard of soil blowing and depth to indurated caliche are the main limitations for most uses. Overgrazing is an important concern of management because it increases the risk of soil blowing and promotes an increase in undesirable plants.

This unit provides habitat for wildlife such as pronghorn antelope, black-tailed jackrabbit, spotted ground squirrel, black-tailed prairie dog, yellow-faced

pocket gopher, Ord's kangaroo rat, northern grasshopper mouse, southern plains woodrat, badger, meadowlark, roadrunner, burrowing owl, white-necked raven, horned lark, loggerhead shrike, mourning dove, scaled quail, sparrow hawk, side-blotched lizard, marbled whiptail, Texas horned lizard, prairie rattlesnake, plains spadefoot toad, and ornate box turtle. Swainson's hawk hunt over this unit in summer, and marsh hawk hunt over it in winter.

5. Sotim-Simona-Pajarito

Shallow and deep, well drained, nearly level to gently sloping soils; on high terraces and on alluvial side slopes below landscape breaks

This map unit is in the south-central part of the survey area. Slope is 0 to 5 percent. The vegetation on this unit is mainly grasses and shrubs. Elevation is 3,600 to 4,000 feet. The average annual precipitation is about 12 inches, the average annual air temperature is about 60 degrees F, and the average frost-free season is about 205 days.

This unit makes up about 7 percent of the survey area. It is about 29 percent Sotim soils, 16 percent Simona soils, and 11 percent Pajarito soils. The remaining 44 percent is components of minor extent.

Sotim soils are in nearly level areas on high terraces. These soils are deep, well drained, and moderately slowly permeable. They formed in calcareous alluvium. The surface layer is reddish brown fine sandy loam about 7 inches thick. The subsoil is reddish brown and light reddish brown loam about 23 inches thick. The substratum to a depth of 60 inches or more is pink clay loam.

Simona soils are in nearly level to gently sloping areas on high terraces. These soils are shallow, well drained, and moderately rapidly permeable. They formed in calcareous alluvium. The surface layer is reddish brown fine sandy loam about 7 inches thick. The subsoil is reddish brown gravelly fine sandy loam about 7 inches thick. An indurated caliche hardpan is at a depth of 14 inches.

Pajarito soils are in nearly level to gently sloping areas on alluvial side slopes below landscape breaks. These soils are deep, well drained, and moderately rapidly permeable. They formed in calcareous alluvium. The surface layer is reddish brown loamy fine sand about 4 inches thick. The subsoil is reddish brown sandy loam about 33 inches thick. The substratum to a depth of 60 inches or more is reddish brown sandy loam.

Of minor extent in this unit are Bascal, Berino, Bluepoint, Dona Ana, Philder, and Poquita, dry, soils; Rock outcrop; Torriorthents; and Yturbide soils.

This unit is used mainly for livestock grazing. It is also used for wildlife habitat. A hazard of soil blowing, low precipitation, and depth to indurated caliche are the main limitations for most uses. Overgrazing is an important

concern of management because it increases the risk of soil blowing and promotes an increase in undesirable plants.

This unit provides habitat for wildlife such as pronghorn antelope, black-tailed jackrabbit, spotted ground squirrel, black-tailed prairie dog, yellow-faced pocket gopher, Ord's kangaroo rat, northern grasshopper mouse, southern plains woodrat, badger, meadowlark, roadrunner, burrowing owl, white-necked raven, horned lark, loggerhead shrike, mourning dove, scaled quail, sparrow hawk, side-blotched lizard, marbled whiptail, Texas horned lizard, prairie rattlesnake, plains spadefoot toad, and ornate box turtle. Swainson's hawk hunt over the unit in summer, and marsh hawk hunt over it in winter.

Soils on flood plains

This group consists of one map unit. It makes up about 2 percent of the survey area. The native vegetation is mainly grasses and shrubs. Elevation is 3,500 to 3,700 feet. The average annual precipitation is about 12 inches, the average annual air temperature is about 60 degrees F, and the average frost-free season is about 205 days.

The soils in this group formed in alluvium.

This group is used mainly for livestock grazing. It is also used for wildlife habitat and as irrigated cropland.

6. Glendale-Ustifluvents-Harkey

Deep, somewhat poorly drained and well drained, nearly level soils; on flood plains

This map unit is in the south-central part of the survey area. Slope is 0 to 2 percent. The vegetation on this unit is mainly grasses and shrubs. Elevation is 3,500 to 3,700 feet. The average annual precipitation is about 12 inches, the average annual air temperature is about 60 degrees F, and the average frost-free season is about 205 days.

This unit makes up about 2 percent of the survey area. It is about 35 percent Glendale soils; 31 percent Ustifluvents, frequently flooded; and 14 percent Harkey soils. The remaining 20 percent is components of minor extent.

Glendale soils are in nearly level areas on flood plains. These soils are deep, well drained, and moderately slowly permeable. They formed in calcareous alluvium. The surface layer is reddish brown silt loam about 8 inches thick. The substratum to a depth of 60 inches or more is reddish brown, brown, and light reddish brown silt loam.

Ustifluvents, frequently flooded, are in nearly level areas on flood plains. These soils are deep, are somewhat poorly drained, and are moderately permeable to slowly permeable. They formed in alluvium. The surface layer is brown and light brown loam about 18 inches thick. The substratum to a depth of 60 inches or

more is highly stratified, but it is dominantly strong brown very fine sandy loam, light brown and strong brown loamy fine sand, and brown silty clay loam.

Harkey soils are in nearly level areas on flood plains. These soils are deep, well drained, and moderately permeable. They formed in calcareous alluvium. The surface layer is brown very fine sandy loam about 7 inches thick. The substratum to a depth of 60 inches or more is yellowish brown very fine sandy loam and loam.

Of minor extent in this unit are Alama, Reakor, and Pecos soils.

This unit is used mainly for livestock grazing. It is also used for wildlife habitat and irrigated crops. A hazard of soil blowing, slow permeability, and a hazard of flooding are the main limitations for most uses. Overgrazing is an important concern of management because it increases the risk of soil blowing and promotes an increase in undesirable plants.

This unit provides habitat for wildlife such as black-tailed jackrabbit, yellow-faced pocket gopher, coyote, meadowlark, mourning dove, scaled quail, sparrow hawk, western spadefoot toad, and western diamondback rattlesnake.

In areas where riparian vegetation grows along the Pecos River, the resident animal community is characterized by raccoon, gray fox, muskrat, red-winged blackbird, summer tanager, ferruginous hawk, mourning dove, killdeer, tree lizard, eastern fence lizard, tiger salamander, leopard frog, bullfrog, and checkered garter snake.

Bullock's oriole, blue grosbeak, painted bunting, Swainson's hawk, and mourning dove nest on this unit. Yellow-throated warblers nest in areas where aquatic plants grow. Sandhill crane and long-billed curlew winter along the Pecos River, and American avocet and black-necked stilt use this unit during migration. The golden eagle uses large trees for roosting and, occasionally, for nesting.

Soils on terraces

This group consists of one map unit. It makes up about 14 percent of the survey area. The native vegetation is mainly grasses and shrubs. Elevation is 3,500 to 4,500 feet. The average annual precipitation is about 12 to 13 inches, the average annual air temperature is about 60 degrees F, and the average frost-free season is 200 to 205 days.

The soils in this group formed in calcareous, gypsiferous alluvium and residuum.

This group is used mainly for livestock grazing. It is also used for wildlife habitat, irrigated cropland, and urban development.

7. Hollomex-Reeves-Milner

Deep, well drained, nearly level to undulating soils; on terraces

This map unit is in the central part of the survey area. Slope is 0 to 8 percent. The vegetation on this unit is mainly grasses and shrubs. Elevation is 3,500 to 4,500 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 60 degrees F, and the average frost-free season is about 200 days.

This unit makes up about 14 percent of the survey area. It is about 35 percent Hollomex soils, 20 percent Reeves soils, and 17 percent Milner soils. The remaining 28 percent is components of minor extent.

Hollomex soils are in nearly level areas on terrace fronts. These soils are deep, well drained, and moderately permeable. They formed in calcareous, gypsiferous alluvium and residuum. The surface layer is light brown loam about 5 inches thick. The substratum to a depth of 60 inches or more is very pale brown and pale yellow, gypsiferous loam.

Reeves soils are in nearly level areas on high terraces. These soils are deep, well drained, and moderately permeable. They formed in alluvium derived dominantly from calcareous material high in content of gypsum. The surface layer is brown and light brown loam about 8 inches thick. The subsoil is yellowish red loam and reddish yellow loam and clay loam about 16 inches thick. The substratum to a depth of 60 inches or more is reddish yellow, gypsiferous sandy loam and yellowish red, gypsiferous loam.

Milner soils are in nearly level to undulating areas on terraces. These soils are deep, well drained, and moderately permeable. They formed in calcareous, gypsiferous alluvium. The surface layer is reddish brown loam about 3 inches thick. The subsoil is reddish brown clay loam about 10 inches thick. The substratum to a depth of 60 inches or more is pink, gypsiferous clay loam.

Of minor extent in this unit are Alama, Bascal, Bluepoint, Dona Ana, and Glendale soils; Gypsum land; Harkey, Pajarito, Philder, and Poquita soils; Rock outcrop; Sotim soils; Torriorthents; and Yturbide soils.

This unit is used mainly for livestock grazing. It is also used for wildlife habitat, irrigated crops, and urban development. A hazard of soil blowing, low precipitation, and shallow depth to gypsum beds are the main limitations for most uses. Overgrazing is an important concern of management because it increases the risk of soil blowing and gullyng and promotes an increase in undesirable plants.

This unit provides habitat for wildlife such as coyote, desert cottontail, spotted ground squirrel, white-throated woodrat, sparrow hawk, scaled quail, loggerhead shrike, mourning dove, Texas horned lizard, lesser earless lizard, and western diamondback rattlesnake. In addition, especially in areas of steep breaks, the unit supports populations of bobcat, gray fox, and rock squirrel. Prairie falcon and golden eagle may hunt over the unit.

Soils on alluvial side slopes, alluvial fans, valley floors, terraces, uplands, ridges, and hills

This group consists of six map units. It makes up about 28 percent of the survey area. The native vegetation is mainly grasses and shrubs. Elevation is 3,550 to 4,700 feet. The average annual precipitation is about 12 to 14 inches, the average annual air temperature is 55 to 60 degrees F, and the average frost-free season is 185 to 200 days.

The soils in this group formed in calcareous alluvial, residual, and eolian material.

This group is used mainly for livestock grazing. It is also used for wildlife habitat and irrigated crops.

8. Poquita-Alama-Hodgins

Deep, well drained, nearly level to undulating soils; on alluvial side slopes

This map unit is in the western part of the survey area. Slope is 0 to 3 percent. The vegetation on this unit is mainly grasses and shrubs. Elevation is 3,800 to 4,600 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 60 degrees F, and the average frost-free season is about 200 days.

This unit makes up about 5 percent of the survey area. It is about 38 percent Poquita soils, 27 percent Alama soils, and 7 percent Hodgins soils. The remaining 28 percent is components of minor extent.

Poquita soils are in nearly level to undulating areas on alluvial side slopes. These soils are deep, well drained, and moderately permeable. They formed in loamy, calcareous alluvium. The surface layer is reddish brown and yellowish red very fine sandy loam and loam about 6 inches thick. The subsoil is reddish yellow clay loam about 18 inches thick. The upper 29 inches of the substratum is light red clay loam, and the lower part to a depth of 60 inches or more is light red loamy fine sand.

Alama soils are in nearly level to undulating areas on alluvial side slopes. These soils are deep, well drained, and moderately slowly permeable. They formed in calcareous alluvium. The surface layer is strong brown loam about 6 inches thick. The subsoil is reddish brown and yellowish red clay loam about 27 inches thick. The substratum to a depth of 60 inches or more is yellowish red clay loam.

Hodgins soils are in nearly level to undulating areas on alluvial side slopes. These soils are deep, well drained, and moderately permeable. They formed in alluvium derived dominantly from limestone. The surface layer is pale brown silt loam about 3 inches thick. The subsoil is yellowish brown silt loam and pale brown silty clay loam about 39 inches thick. The substratum to a depth of 60 inches or more is yellowish brown silty clay loam.

Of minor extent in this unit are Conger, Ector, Hollomex, Milner, Ranstein, Reagan, and Reeves soils.

This unit is used mainly for livestock grazing. It is also used for wildlife habitat. Soil blowing is the main limitation for most uses. Overgrazing is an important concern of management because it increases the risk of soil blowing and promotes an increase in undesirable plants.

This unit provides habitat for wildlife such as pronghorn antelope, black-tailed jackrabbit, black-tailed prairie dog, yellow-faced pocket gopher, banner-tailed kangaroo rat, hispid cotton rat, swift fox, burrowing owl, horned lark, mockingbird, meadowlark, mourning dove, scaled quail, Great Plains toad, plains spadefoot toad, prairie rattlesnake, and western coachwhip snake.

9. Reakor-Alama-Bascal

Deep, well drained, nearly level to sloping soils; on alluvial side slopes, alluvial fans, and terraces

This map unit is in the south-central part of the survey area. Slope is 0 to 12 percent. The vegetation on this unit is mainly grasses and shrubs. Elevation is 3,550 to 4,300 feet. The average annual precipitation is about 12 inches, the average annual air temperature is about 60 degrees F, and the average frost-free season is about 205 days.

This unit makes up about 4 percent of the survey area. It is about 34 percent Reakor soils, 22 percent Alama soils, and 11 percent Bascal soils. The remaining 33 percent is components of minor extent.

Reakor soils are in nearly level areas on alluvial side slopes and low terraces. These soils are deep, well drained, and moderately permeable. They formed in calcareous alluvium derived dominantly from limestone. The surface layer is pale brown and yellowish brown silt loam about 7 inches thick. The subsoil is light yellowish brown and pink silty clay loam about 31 inches thick. The substratum to a depth of 60 inches or more is light brown and pink silty clay loam.

Alama soils are in nearly level to gently sloping areas on alluvial fans, alluvial side slopes, and terraces. These soils are deep, well drained, and moderately slowly permeable. They formed in calcareous alluvium. The surface layer is strong brown loam about 6 inches thick. The subsoil is reddish brown and yellowish red clay loam about 27 inches thick. The substratum to a depth of 60 inches or more is yellowish red clay loam.

Bascal soils are in nearly level to sloping areas on terraces. These soils are deep, well drained, and moderately permeable. They formed in calcareous alluvium. The surface layer is light brown gravelly sandy loam about 7 inches thick. The upper 29 inches of the substratum is pink very gravelly sandy clay loam, and the lower part to a depth of 60 inches or more is reddish yellow very gravelly coarse sandy loam.

Of minor extent in this unit are Bigetty; Hollomex; Milner, dry; Poquita, dry; and Reeves soils.

This unit is used mainly for livestock grazing. It is also used for wildlife habitat and irrigated crops. A hazard of

soil blowing is the main limitation for most uses. Overgrazing is an important concern of management because it increases the risk of soil blowing and promotes an increase in undesirable plants.

This unit provides habitat for wildlife such as pronghorn antelope, black-tailed jackrabbit, black-tailed prairie dog, yellow-faced gopher, kangaroo rat, hispid cotton rat, swift fox, burrowing owl, horned lark, mockingbird, meadowlark, mourning dove, scaled quail, plains spadefoot toad, prairie rattlesnake, and western coachwhip snake.

10. Ector

Shallow, well drained, nearly level to rolling soils; on ridges and hills

This map unit is in the western part of the survey area. Slope is 3 to 15 percent. The vegetation on this unit is mainly grasses and shrubs. Elevation is 3,700 to 4,300 feet. The average annual precipitation is about 12 inches, the average annual air temperature is about 60 degrees F, and the average frost-free season is about 205 days.

This unit makes up about 3 percent of the survey area. It is about 69 percent Ector soils. The remaining 31 percent is components of minor extent.

Ector soils are moderately permeable. They formed in residuum derived dominantly from limestone. The surface layer is brown extremely cobbly loam about 11 inches thick. The substratum is brown extremely cobbly loam about 6 inches thick. Unweathered limestone is at a depth of 17 inches.

Of minor extent in this unit are Reakor soils, Rock outcrop, and Upton soils.

This unit is used mainly for livestock grazing. It is also used for wildlife habitat. Shallow depth to limestone, slope, a hazard of soil blowing, and low precipitation are the main limitations for most uses. Overgrazing is an important concern of management because it increases the risk of soil blowing and gullyng and promotes an increase of undesirable plants.

This unit provides habitat for wildlife such as desert cottontail, rock black-throated sparrow, scaled quail, collared lizard, Couch's spadefoot toad, red-spotted toad, rock rattlesnake, and western coachwhip snake. White-throated swift, prairie falcon, and golden eagle nest on the unit and hunt over it.

11. Ector-Conger-Reagan

Shallow and deep, well drained, nearly level to hilly soils; on ridges, hills, and uplands

This map unit is in the western part of the survey area. Slope is 0 to 30 percent. The vegetation on this unit is mainly grasses and shrubs. Elevation is 3,700 to 4,700 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 59

degrees F, and the average frost-free season is about 195 days.

This unit makes up about 7 percent of the survey area. It is about 41 percent Ector soils, 14 percent Conger soils, and 8 percent Reagan soils. The remaining 37 percent is components of minor extent.

Ector soils are in nearly level to moderately steep and hilly areas on ridges and hills. These soils are shallow, well drained, and moderately permeable. They formed in residuum derived dominantly from limestone. The surface layer is brown extremely cobbly loam about 11 inches thick. The substratum is brown extremely cobbly loam about 6 inches thick. Unweathered limestone is at a depth of 17 inches.

Conger soils are in nearly level to gently sloping areas on uplands. These soils are shallow, well drained, and moderately permeable. They formed in calcareous alluvium. The surface layer is brown loam about 3 inches thick. The subsoil is brown cobbly silt loam about 9 inches thick. An indurated caliche hardpan is at a depth of 12 inches.

Reagan soils are in nearly level areas on side slopes and in depressional areas on uplands. These soils are deep, well drained, and moderately permeable. They formed in calcareous alluvium derived dominantly from limestone. The surface layer is yellowish brown silt loam and brown silty clay loam about 10 inches thick. The subsoil is brown, light brown, and pink silty clay loam about 34 inches thick. The substratum to a depth of 60 inches or more is pink silty clay loam.

Of minor extent in this unit are Blakeney, Hodgins, Ima, Kimbrough, and Ranstein soils; Rock outcrop; and Roswell soils.

This unit is used mainly for livestock grazing. It is also used for wildlife habitat. Shallow soil depth, a hazard of soil blowing, and slope are the main limitations for most uses. Overgrazing is an important concern of management because it increases the risk of soil blowing and gullyng and promotes an increase of undesirable plants.

This unit provides habitat for wildlife such as desert cottontail, yellow-faced pocket gopher, white-throated woodrat, scaled quail, Texas horned lizard, plains spadefoot toad, red-spotted toad, prairie rattlesnake, and western coachwhip snake. In addition, white-throated swift, prairie falcon, and golden eagle nest on the unit and hunt over it.

12. Threadgill-Asparas-Gabaldon

Deep, well drained, nearly level to gently sloping soils; on alluvial side slopes and in depressional areas and drainageways

This map unit is in the western part of the survey area. Slope is 0 to 5 percent. The vegetation on this unit is mainly grasses and shrubs. Elevation is 4,200 to 4,600 feet. The average annual precipitation is about 14 inches, the average annual air temperature is about 55

degrees F, and the average frost-free season is about 185 days.

This unit makes up about 1 percent of the survey area. It is about 45 percent Threadgill soils, 28 percent Asparas soils, and 11 percent Gabaldon soils. The remaining 16 percent is components of minor extent.

Threadgill soils are in nearly level to gently sloping areas in drainageways and on alluvial side slopes. These soils are deep, well drained, and moderately slowly permeable. They formed in calcareous alluvium derived dominantly from limestone. The surface layer is dark yellowish brown silt loam about 5 inches thick. The subsoil is brown and light brown silty clay loam about 31 inches thick. The substratum to a depth of 60 inches or more is light brown silty clay loam.

Asparas soils are in nearly level areas on alluvial side slopes and in depressional areas. These soils are deep, well drained, and moderately slowly permeable. They formed in alluvium derived dominantly from limestone. The surface layer is dark grayish brown loam about 4 inches thick. The subsoil is very dark grayish brown and brown loam and clay loam about 34 inches thick. The substratum to a depth of 60 inches or more is light brown clay loam.

Gabaldon soils are in nearly level areas in drainageways. These soils are deep, well drained, and moderately permeable. They formed in calcareous alluvium derived dominantly from limestone. The surface layer is dark grayish brown silty clay loam about 28 inches thick. The subsoil is brown silty clay loam about 12 inches thick. The substratum to a depth of 60 inches or more is brown silt loam.

Of minor extent in this unit are Darvey, Deama, and Pastura soils.

This unit is used mainly for livestock grazing. It is also used for wildlife habitat. The hazards of soil blowing and flooding are the main limitations for most uses. Overgrazing is an important concern of management because it increases the risk of soil blowing and promotes an increase of undesirable plants.

This unit provides habitat for wildlife such as black-tailed jackrabbit, badger, yellow-faced pocket gopher, coyote, desert cottontail, sparrow hawk, meadowlark, lark bunting, killdeer, tiger salamander, Woodhouses' toad, and bullsnake.

13. Darvey-Deama-Pastura

Shallow and deep, well drained, nearly level to hilly soils; on alluvial side slopes, valley floors, ridges, back slopes, and foot slopes

This map unit is in the northwestern part of the survey area. Slope is 0 to 30 percent. The vegetation on this unit is mainly grasses and shrubs. Elevation is 4,000 to 5,000 feet. The average annual precipitation is about 14 inches, the average annual air temperature is about 55

degrees F, and the average frost-free season is about 185 days.

This unit makes up about 8 percent of the survey area. It is about 23 percent Darvey soils, 22 percent Deama soils, and 17 percent Pastura soils. The remaining 38 percent is components of minor extent.

Darvey soils are in nearly level to gently sloping areas on alluvial side slopes and valley floors of plateaus. These soils are deep, well drained, and moderately permeable. They formed in calcareous alluvium derived dominantly from limestone. The surface layer is brown loam about 4 inches thick. The subsoil is brown loam and light brown clay loam about 33 inches thick. The substratum to a depth of 60 inches or more is pink, light brown, and reddish brown clay loam.

Deama soils are in nearly level to hilly areas on ridges and back slopes. These soils are shallow, well drained, and moderately permeable. They formed in residuum derived dominantly from limestone. The surface layer is brown gravelly loam and brown extremely cobbly loam about 10 inches thick. Unweathered limestone is at a depth of 10 inches.

Pastura soils are in nearly level to gently sloping areas on ridges and foot slopes. These soils are shallow, well

drained, and moderately permeable. They formed in calcareous alluvial and eolian material. The surface layer is brown loam about 8 inches thick. The subsoil is brown clay loam about 3 inches thick. The substratum is brown cobbly loam about 6 inches thick. A caliche hardpan is at a depth of 17 inches.

Of minor extent in this unit are Hogadero and Pena soils, Rock outcrop, and Threadgill soils.

This unit is used mainly for livestock grazing. It is also used for wildlife habitat. A hazard of soil blowing, shallow soil depth, and slope are the main limitations for most uses. Overgrazing is an important concern of management because it increases the risk of soil blowing and gullyng and promotes an increase of undesirable plants.

This unit provides habitat for wildlife such as desert cottontail, rock squirrel, yellow-faced pocket gopher, white-throated woodrat, ringtail bobcat, black-throated sparrow, scaled quail, collared lizard, Couch's spadefoot toad, red-spotted toad, rock rattlesnake, and western coachwhip snake. The white-throated swift, prairie falcon, and golden eagle nest on this unit and hunt over it.

Detailed Soil Map Units

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

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

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

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

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

Some map units are made up of two or more major soils. These map units are called soil complexes and soil associations.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Hollomex, moist-Milner-Reeves, moist loams, moderately undulating, is an example.

A *soil association* is made up of two or more geographically associated soils that are shown as one unit on the maps. Because of present or anticipated soil uses in the survey area, it was not considered practical or necessary to map the soils separately. The pattern and relative proportion of the soils are somewhat similar.

Blakeney-Ratliff association, moderately undulating, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

This survey was mapped at two levels of detail. At the most detailed level, map units are narrowly defined. This means that soil boundaries were plotted and verified at closely spaced intervals. At the less detailed level, map units are broadly defined. Soil boundaries were plotted and verified at wider intervals. In the soil map legend, narrowly defined units are identified by symbols in which the first letter is a capital and the second is lower case. For broadly defined units, the first and second letters are capitals. 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.

Table 2 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Map Unit Descriptions

AaA—Alama silt loam, 0 to 1 percent slopes. This deep, well drained soil is on alluvial fans and side slopes in the south-central part of the survey area. It formed in calcareous alluvium. Areas are elongated or irregular in shape and are 25 to 350 acres in size. The vegetation in areas not cultivated is mainly grasses and shrubs. Elevation is 3,650 to 3,950 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

Typically, the surface layer is brown silt loam about 6 inches thick. The subsoil is 26 inches thick. The upper 14 inches of the subsoil is brown and light brown silty clay loam, and the lower 12 inches is reddish yellow silt loam. The substratum to a depth of 60 inches or more is reddish yellow silt loam.

Included in this unit are small areas of dark-colored soils that have a clay increase in the subsoil and are in slightly depressional areas, soils that have a coarser textured subsoil and substratum than this Alama soil, and Reeves soils in slightly depressional areas. Also included are small areas of Alama silt loam, 1 to 3 percent slopes. Included areas make up about 10 percent of the total acreage.

Permeability of this Alama soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for irrigated crops, hay and pasture, urban development, and wildlife habitat. The main crops are alfalfa, cotton, and grain sorghum. Among the other crops grown is small grain. Some areas are used for permanent pasture.

This unit is well suited to all crops commonly grown in the survey area. It is limited mainly by poor tilth.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to the unit. The method used generally is governed by the crop grown. If irrigation is planned, the quality of water should be tested. Using water of poor quality may necessitate an adjustment in the types of crops planted. Irrigation water should be applied at a rate that insures optimum production without increasing deep percolation, runoff, and erosion. It should be applied in amounts sufficient to wet the root zone but in amounts small enough to minimize the leaching of plant nutrients. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Leveling helps to insure the uniform application of water. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

The organic matter content of the soil can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes an adequate amount of soil improving crops such as alfalfa or high residue crops. A cropping system that returns a high residue crop to the soil once every 4 years helps to maintain soil tilth. If legumes or grasses are grown in the cropping system, species should be selected that can be maintained on the land for at least 3 years. Fertilizer commonly is used. The application of fertilizer should be based on the needs of the crops grown. Using management that maintains optimum vigor and quality of forage plants is a suitable practice.

Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Soil blowing can also be reduced by keeping the soil rough and cloddy when it is not protected by vegetation, by seeding disturbed areas to native or tame pasture plants, by returning crop residue to the soil, and by practicing minimum tillage.

If this unit is used for urban development, the main limitations are the moderately slow permeability, moderate shrink-swell potential, and a high hazard of soil blowing during construction. If buildings are constructed on the unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling. Preserving as much of the existing plant cover as possible during construction and promptly revegetating disturbed areas around construction sites help to control water erosion and soil blowing.

AaB—Alama silt loam, 1 to 3 percent slopes. This deep, well drained soil is on alluvial fans and side slopes in the south-central part of the survey area. It formed in calcareous alluvium. Areas are elongated or irregular in shape and are 20 to 325 acres in size. The vegetation in areas not cultivated is mainly grasses and shrubs. Elevation is 3,650 to 3,950 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

Typically, the surface layer is brown silt loam about 3 inches thick. The subsoil is 32 inches thick. The upper 6 inches of the subsoil is light brown silt loam, and the lower 26 inches is light brown and pink silty clay loam. The substratum to a depth of 60 inches or more is pink silt loam.

Included in this unit are small areas of soils that have a gravelly surface layer and are on ridges, soils that have a coarser textured subsoil and substratum than this Alama soil, soils that have slopes of more than 3 percent, and Reeves soils in slightly depressional areas. Also included are small areas of Alama silt loam, 0 to 1 percent slopes. Included areas make up about 15 percent of the total acreage.

Permeability of this Alama soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for irrigated crops, hay and pasture, urban development, and wildlife habitat. The main crops are alfalfa, cotton, and grain sorghum. Among the other crops grown are small grain and permanent pasture.

This unit is well suited to all crops commonly grown in the survey area. It is limited mainly by poor tilth.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to the unit. The method used

generally is governed by the crop grown. If irrigation is planned, the quality of water should be tested. Using water of poor quality may necessitate an adjustment in the types of crops planted. Irrigation water should be applied at a rate that insures optimum production without increasing deep percolation, runoff, and erosion. It should be applied in amounts sufficient to wet the root zone but in amounts small enough to minimize the leaching of plant nutrients. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Leveling helps to insure the uniform application of water. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

The organic matter content of the soil can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes an adequate amount of soil improving crops such as alfalfa and high residue crops. A cropping system that returns a high residue crop to the soil once every 3 years reduces runoff and helps to maintain soil tilth. If legumes or grasses are grown in the cropping system, species should be selected that can be maintained on the land for at least 3 years. Fertilizer commonly is used. The application of fertilizer should be based on the needs of the crops grown. Using management that maintains optimum vigor and quality of forage plants is a good practice.

Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Soil blowing can also be reduced by keeping the soil rough and cloddy when it is not protected by vegetation, by seeding disturbed areas to native or tame pasture plants, by returning crop residue to the soil, and by practicing minimum tillage.

If this unit is used for urban development, the main limitations are moderately slow permeability, moderate shrink-swell potential, and a high hazard of soil blowing during construction. If buildings are constructed on the unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling. Preserving as much of the existing plant cover as possible during construction and promptly revegetating disturbed areas around construction sites help to control water erosion and soil blowing.

AbB—Alama silt loam, dry, 0 to 3 percent slopes. This deep, well drained soil is on alluvial side slopes in the south-central part of the survey area. It formed in calcareous alluvium. Areas are broad and irregular in shape and are 1,000 to 9,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,800 to 4,000 feet. The average annual precipitation is

11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

Typically, the surface layer is yellowish red silt loam about 6 inches thick. The subsoil is red and light red clay loam about 24 inches thick. The substratum to a depth of 60 inches or more is red loam.

Included in this unit are small areas of Poquita and Reeves soils scattered throughout the unit. Included areas make up about 20 percent of the total acreage.

Permeability of this Alama soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly tobosa, blue grama, alkali sacaton, and vine-mesquite. The present vegetation in most areas is mainly tobosa, burrograss, mat muhly, and poverty threawn. This unit also supports important forage plants such as fourwing saltbush. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Mesquite readily invades this unit as the plant community deteriorates. Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as blue grama. Rangeland seeding is not suitable because of the low precipitation.

The average annual production of air-dry vegetation ranges from 1,200 pounds per acre in favorable years to 650 pounds in unfavorable years.

ACA—Alama-Poquita association, nearly level. This map unit is on alluvial side slopes in the north-central part of the survey area. Slope is 0 to 3 percent. Areas are irregular in shape and are 500 to 5,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,900 to 4,500 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is about 200 to 205 days.

This unit is 50 percent Alama loam, 0 to 2 percent slopes, and 40 percent Poquita loam, 0 to 3 percent slopes. The Alama soil is in depressional areas and on smooth side slopes, and the Poquita soil is on low ridges.

Included in this unit are small areas of Blakeney and Bascom soils on ridges, soils that are moderately deep to shale and are on ridges, and clayey soils in depressional areas. Included areas make up about 10 percent of the total acreage.

The Alama soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is strong brown loam about 6 inches thick. The subsoil is reddish brown and yellowish red clay loam about 27 inches thick. The substratum to a depth of 60 inches or more is yellowish red clay loam.

Permeability of the Alama soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Poquita soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is yellowish red loam about 6 inches thick. The subsoil is reddish yellow clay loam about 18 inches thick. The upper 29 inches of the substratum is light red clay loam, and the lower part to a depth of 60 inches or more is light red loamy fine sand.

Permeability of the Poquita soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly blue grama, tobosa, black grama, and alkali sacaton. The present vegetation in most areas is mainly blue grama, tobosa, mat muhly, and fluffgrass. The Alama soil receives runoff from adjoining areas and conveys water to drainageways, resulting in increased production and higher palatability of the forage on this soil; therefore, the soil is often overgrazed. Burrograss, walkingstick cholla, and mesquite readily invade this unit as the plant community deteriorates. Brush management improves deteriorated areas of rangeland that are producing more woody shrubs than were present in the potential plant community. Rangeland seeding is a suitable practice on this unit.

The average annual production of air-dry vegetation ranges from 1,600 pounds per acre in favorable years to 700 pounds in unfavorable years.

APA—Alama-Poquita association, dry, nearly level.

This map unit is on alluvial side slopes in the south-central part of the survey area. Slope is 0 to 3 percent. Areas are rectangular or irregular in shape and are 100 to 1,500 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,600 to 3,850 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

This unit is 40 percent Alama fine sandy loam, 0 to 2 percent slopes, dry, and 40 percent Poquita fine sandy loam, 0 to 3 percent slopes, dry. The Alama soil is in depressional areas, and the Poquita is on low ridges and in depressional areas.

Included in this unit are small areas of soils that have sandstone or shale at a depth of 20 to 40 inches and are on low ridges, Milner and Hollomex soils on low ridges, and soils that have a loam surface layer and are in depressional areas. Included areas make up about 20 percent of the total acreage.

The Alama soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is brown fine sandy loam about 7 inches thick. The subsoil is light brown silt loam about 21 inches thick. The substratum to a depth of 60 inches or more is light brown silt loam.

Permeability of the Alama soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Poquita soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is reddish brown fine sandy loam about 6 inches thick. The subsoil is yellowish red clay loam about 21 inches thick. The substratum to a depth of 60 inches or more is pink clay loam.

Permeability of the Poquita soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly black grama, blue grama, tobosa, and mesa dropseed. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Plants in the potential plant community that increase because of overgrazing are small soapweed and sand sagebrush.

Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as black grama. Rangeland seeding is not suitable because of the low precipitation. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage. The Alama soil has limited suitability for livestock watering ponds and other water impoundments because of the seepage potential.

The average annual production of air-dry vegetation ranges from 1,800 pounds per acre in favorable years to 650 pounds in unfavorable years.

ARA—Alama-Reeves, moist association, nearly level. This map unit is on high terraces in the north-central part of the survey area. Slope is 0 to 3 percent. Areas are broad and irregular in shape and are 500 to 6,000 acres in size. The native vegetation is mainly

grasses and shrubs. Elevation is 3,800 to 4,200 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is about 200 to 210 days.

This unit is 45 percent Alama fine sandy loam, 0 to 3 percent slopes, and 35 percent Reeves fine sandy loam, 0 to 3 percent slopes, moist. The Alama soil is in depressional areas and drainageways, and the Reeves soil is on low ridges.

Included in this unit are small areas of Poquita soils in depressional areas. Also included are areas of Hollomex, moist, and Milner soils and Gypsum land on low ridges. Included areas make up about 20 percent of the total acreage.

The Alama soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is yellowish red fine sandy loam about 4 inches thick. The subsoil is yellowish red silt loam about 34 inches thick. The substratum to a depth of 60 inches or more is yellowish red loam.

Permeability of the Alama soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Reeves soil is deep and well drained. It formed in alluvium derived dominantly from calcareous material high in content of gypsum. Typically, the surface layer is reddish brown fine sandy loam about 8 inches thick. The subsoil is light reddish brown and reddish yellow clay loam about 14 inches thick. The upper 15 inches of the substratum is pink, gypsiferous loam, and the lower part to a depth of 60 inches or more is reddish yellow, gypsiferous sandy loam.

Permeability of the Reeves soil is moderate. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly black grama, blue grama, little bluestem, and fourwing saltbush. The present vegetation in most areas is mainly sand dropseed, tobosa, blue grama, and small soapweed. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

Deferment from grazing during the growing season is needed to maintain or improve the vigor and reproduction of desirable forage plants such as black grama and fourwing saltbush. Rangeland seeding is suitable but is limited because of the low precipitation.

Mesquite readily invades the unit. The Reeves soil is poorly suited to mechanical brush control because of the depth to gypsiferous material. Loss of the surface layer of these soils results in a severe decrease in productivity and in the potential of the unit to produce forage. This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The average annual production of air-dry vegetation ranges from 1,800 pounds per acre in favorable years to 650 pounds in unfavorable years.

ASB—Alama, dry-Pajarito complex, hummocky.

This map unit is on alluvial fans and alluvial side slopes on uplands in the south-central part of the survey area. Slope is 0 to 8 percent. Areas are elongated or irregular in shape and are 500 to 2,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,600 to 4,000 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

This unit is 50 percent Alama silt loam, 0 to 5 percent slopes, dry, and 25 percent Pajarito loamy very fine sand, 0 to 8 percent slopes. The Alama soil is in interdunal areas, on low ridges, and in depressional areas, and the Pajarito soil is on low ridges and coppice dunes. The components of this unit are so intricately intermingled that it was not practical to map them separately.

Included in this unit are small areas of Hollomex soils on low knolls and ridges; Milner, moist, and Reeves soils on low ridges and knolls; Glendale and Harkey soils in narrow drainageways; and Poquita soils on low ridges. Included areas make up about 25 percent of the total acreage.

The Alama soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is brown silt loam about 16 inches thick. The substratum to a depth of 60 inches or more is yellowish red loam.

Permeability of the Alama soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Pajarito soil is deep and well drained. It formed in calcareous alluvial deposits. Typically, the surface layer is reddish brown loamy fine sand about 4 inches thick. The subsoil is 56 inches thick. The upper 29 inches of the subsoil is yellowish red loamy very fine sand, and the lower 27 inches is reddish brown loam.

Permeability of the Pajarito soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is very high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly black grama, little bluestem, mesa dropseed, and hooded windmillgrass. The present vegetation in most areas is mainly sand dropseed, sand sagebrush, shinnery oak, and silver bluestem. The Alama soil can support scattered fourwing saltbush. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. In areas where shinnery oak is dominant, livestock should be removed when the shinnery oak is in late bud or early leaf stage because of its toxicity during this period. Sand sagebrush readily invades these soils as the plant community deteriorates.

If the plant cover is disturbed, protection is needed to control gullying, streambank cutting, and sheet erosion. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage.

The average annual production of air-dry vegetation on this unit ranges from 1,100 pounds per acre in favorable years to 600 pounds in unfavorable years.

BAC—Bascal-Alama, dry association, moderately rolling. This map unit is on old alluvial terraces in the south-central part of the survey area. Slope is 0 to 12 percent. Areas are elongated or irregular in shape and are 500 to 2,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,600 to 4,000 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

This unit is 55 percent Bascal gravelly loam, 2 to 12 percent slopes, and 35 percent Alama loam, 0 to 3 percent slopes, dry. The Bascal soil is on ridges, and the Alama soil is on alluvial side slopes and in depressional areas.

Included in this unit are small areas of Upton soils on ridgetops, shallow soils that are more than 35 percent rock fragments and are on ridgetops, and Reakor soils on alluvial side slopes and in depressional areas. Included areas make up about 10 percent of the total acreage.

The Bascal soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is brown and light brown gravelly loam about 9 inches thick. The upper 11 inches of the substratum is light brown very gravelly loam, the next 15 inches is pink very gravelly clay loam, and the lower part to a depth of 60 inches or more is pink very gravelly loam.

Permeability of the Bascal soil is moderate. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

The Alama soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is brown silt loam about 9 inches thick. The subsoil is yellowish red silty clay loam about 22 inches thick. The upper 19 inches of the substratum is reddish yellow silty clay loam, and the lower part to a depth of 60 inches or more is reddish yellow silt loam.

Permeability of the Alama soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Bascal soil is mainly black grama, plains bristlegrass, blue grama, and creosotebush. The present vegetation in most areas is mainly hairy grama, creosotebush, sand dropseed, and littleleaf sumac. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Deferment from grazing during the growing season is needed to maintain or improve the vigor and reproduction of desirable forage plants such as black grama. Rangeland seeding is not suitable because of the low precipitation. This soil has limited suitability for livestock watering ponds and other water impoundments because of the seepage potential.

The average annual production of air-dry vegetation on this soil ranges from 800 pounds per acre in favorable years to 300 pounds in unfavorable years.

The potential plant community on the Alama soil is mainly black grama, blue grama, tobosa, and mesa dropseed. The present vegetation in most areas is mainly sand dropseed, tobosa, and black grama. This soil receives runoff from adjoining areas and conveys water to drainageways, resulting in increased production and higher palatability of the forage. Areas of this soil, therefore, are often overgrazed. If the soil is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The average annual production of air-dry vegetation on this soil ranges from 1,800 pounds per acre in favorable years to 650 pounds in unfavorable years.

BBB—Bascal-Sotim association, moderately undulating. This map unit is on high terraces in the

south-central part of the survey area. Slope is 0 to 7 percent. Areas are elongated or irregular in shape and are 500 to 3,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,650 to 3,750 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

This unit is 55 percent Bascal gravelly sandy loam, 2 to 7 percent slopes, and 35 percent Sotim fine sandy loam, 0 to 2 percent slopes. The Bascal soil is on ridges, and the Sotim soil is in depressional areas.

Included in this unit are small areas of Simona soils on ridges and side slopes. Also included are areas of Alama and Berino soils in depressional areas. Included areas make up about 10 percent of the total acreage.

The Bascal soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is light brown gravelly sandy loam about 7 inches thick. The upper 29 inches of the substratum is pink very gravelly sandy clay loam, and the lower part to a depth of 60 inches or more is reddish yellow very gravelly coarse sandy loam.

Permeability of the Bascal soil is moderate. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Sotim soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is brown fine sandy loam about 6 inches thick. The subsoil is strong brown loam about 16 inches thick. The substratum to a depth of 60 inches or more is strong brown and pink clay loam.

Permeability of the Sotim soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Bascal soil is mainly black grama, bush muhly, common javalinabush, and sideoats grama. The present vegetation in most areas is mainly common javalinabush, hairy tridens, blue grama, and creosotebush. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Plants in the potential plant community that increase because of overgrazing are catclaw acacia and broom snakeweed. Rangeland improvement practices such as livestock water pipelines and fences are difficult to install on this soil because of its content of rock fragments. Rangeland seeding is not suitable because of the content of rock fragments and the low precipitation.

The average annual production of air-dry vegetation on this soil ranges from 800 pounds per acre in favorable years to 300 pounds in unfavorable years.

The potential plant community on the Sotim soil is mainly black grama, mesa dropseed, hooded windmillgrass, and small soapweed. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Rangeland seeding is not suitable because of the low precipitation.

The average annual production of air-dry vegetation on this soil ranges from 1,100 pounds per acre in favorable years to 600 pounds in unfavorable years.

This unit supports important forage plants such as Mormon-tea. Deferment from grazing during the growing season is needed to maintain or improve the vigor and reproduction of desirable forage plants such as black grama. Pale wolfberry readily invades the unit as the plant community deteriorates.

BCB—Bascom-Ratliff association, moderately undulating. This map unit is on alluvial terraces in the north-central part of the survey area. Slope is 0 to 7 percent. Areas are elongated and narrow in shape and are 300 to 2,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,750 to 3,800 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is about 200 to 210 days.

This unit is 55 percent Bascom gravelly sandy loam, 2 to 7 percent slopes, and 30 percent Ratliff fine sandy loam, 0 to 2 percent slopes. The Bascom soil is on ridges, and the Ratliff soil is in depressional areas.

Included in this unit are small areas of Blakeney soils on ridges. Also included are areas of Alama and Redona soils in depressional areas. Included areas make up about 15 percent of the total acreage.

The Bascom soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is brown gravelly sandy loam and brown gravelly loam about 12 inches thick. The upper 14 inches of the substratum is pink extremely gravelly sandy clay loam, the next 10 inches is light brown very gravelly sandy clay loam, and the lower part to a depth of 60 inches or more is pink extremely gravelly fine sandy loam.

Permeability of the Bascom soil is moderate. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Ratliff soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is brown fine sandy loam about 6 inches thick. The subsoil is 54 inches thick. The upper 30 inches of the subsoil is strong

brown sandy clay loam, and the lower 24 inches is pink sandy clay loam.

Permeability of the Ratliff soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Bascom soil is mainly black grama, sideoats grama, hairy grama, and catclaw mimosa. The present vegetation in most areas is mainly catclaw mimosa, hairy grama, hairy tridens, and black grama.

The potential plant community on the Ratliff soil is mainly black grama, sand dropseed, blue grama, and hooded windmillgrass. The present vegetation in most areas is mainly bush muhly, sand dropseed, poverty threeawn, and plains bristlegrass.

This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Mesquite readily invades this unit as the plant community deteriorates.

The average annual production of air-dry vegetation on this unit ranges from 800 pounds per acre in favorable years to 300 pounds in unfavorable years.

BeA—Berino loamy fine sand, 0 to 2 percent slopes. This deep, well drained soil is on high terraces in the south-central part of the survey area. It formed in alluvial and eolian deposits. Areas are rectangular or irregular in shape and are 500 to 1,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,700 to 3,800 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

Typically, the surface layer is reddish brown loamy fine sand about 13 inches thick. The subsoil is reddish brown and yellowish red sandy clay loam about 27 inches thick. The substratum to a depth of 60 inches or more is pinkish white sandy clay loam.

Included in this unit are small areas of Bluepoint soils on low dunes, soils that are 20 to 40 inches deep to indurated caliche and are on low ridges, and soils that have a sandy layer more than 20 inches thick. Included areas make up about 20 percent of the total acreage.

Permeability of the Berino soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is very high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly little bluestem, black grama, mesa dropseed, and plains bristlegrass. The unit supports important forage plants such as fourwing saltbush and Mormon-tea. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. A plant in the potential plant community that increases because of overgrazing is small soapweed. Mesquite readily invades the unit.

Rangeland seeding is not suitable because of the low precipitation. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Livestock grazing should be managed to protect the unit from excessive erosion.

The average annual production of air-dry vegetation on this unit ranges from 1,800 pounds per acre in favorable years to 650 pounds in unfavorable years.

BPB—Berino-Bluepoint complex, hummocky. This map unit is on high terraces in the south-central part of the survey area. Slope is 0 to 5 percent. Areas are irregular in shape and are 500 to 2,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,600 to 3,800 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

This unit is 45 percent Berino sandy clay loam, 0 to 2 percent slopes, eroded, and 40 percent Bluepoint loamy fine sand, 2 to 5 percent slopes. The Berino soil is in interdunal areas, and the Bluepoint soil is on coppice dunes.

Included in this unit are small areas of Berino loamy fine sand in noneroded areas and soils that have a sandy clay loam subsoil at a depth of 20 to 40 inches and are on coppice dunes. Also included are small areas of Yturbide soils on side slopes. Included areas make up about 15 percent of the total acreage.

The Berino soil is deep and well drained. It formed in alluvial and eolian deposits. Typically, the original surface layer has been lost through erosion. The subsoil is reddish brown sandy clay loam about 34 inches thick. The substratum to a depth of 60 inches or more is pink sandy clay loam.

Permeability of the Berino soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

The Bluepoint soil is deep and somewhat excessively drained. It formed in calcareous eolian deposits. Typically, the surface layer is reddish brown loamy fine

sand about 10 inches thick. The substratum to a depth of 60 inches or more is reddish brown loamy fine sand.

Permeability of the Bluepoint soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly little bluestem, black grama, New Mexico feathergrass, and hooded windmillgrass. Fourwing saltbush is scattered throughout the plant community. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Sand sagebrush readily invades the unit as the plant community deteriorates. Plants in the potential plant community that increase because of overgrazing are sand dropseed and small soapweed.

Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as black grama. Rangeland seeding is not suitable because of the low precipitation. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage. This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The average annual production of air-dry vegetation on this unit ranges from 1,800 pounds per acre in favorable years to 650 pounds in unfavorable years.

BQB—Blakeney-Ima association, moderately undulating. This map unit is on uplands in the southwestern part of the survey area. Slope is 0 to 5 percent. Areas are elongated or rounded in shape and are 1,300 to 2,200 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,000 to 4,400 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 58 to 60 degrees F, and the average frost-free period is 190 to 200 days.

This unit is 50 percent Blakeney fine sandy loam, 0 to 5 percent slopes, and 40 percent Ima loamy fine sand, 0 to 3 percent slopes. The Blakeney soil is on ridges, and the Ima soil is on upland plains.

Included in this unit are small areas of Kimbrough, dry, soils on ridges, Reagan soils in depressional areas and on toe slopes of ridges, and Ratliff soils on upland plains. Included areas make up about 10 percent of the total acreage.

The Blakeney soil is shallow and well drained. It formed in calcareous eolian and alluvial deposits. Typically, the surface layer is dark yellowish brown fine sandy loam about 3 inches thick. The subsoil is dark

brown fine sandy loam about 10 inches thick. Indurated caliche is at a depth of 13 inches.

Permeability of the Blakeney soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 8 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Ima soil is deep and well drained. It formed in alluvium. Typically, the upper 5 inches of the surface layer is dark yellowish brown loamy fine sand and the lower 9 inches is yellowish brown fine sandy loam. The subsoil is light brown fine sandy loam 28 inches thick. The substratum to a depth of 60 inches or more is light brown fine sandy loam.

Permeability of the Ima soil is moderately rapid. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is very high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly black grama, little bluestem, blue grama, and New Mexico feathergrass. The present vegetation in most areas is mainly blue grama, sand dropseed, tobosa, and spiny allthorn. Fourwing saltbush is scattered throughout the plant community. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Spiny allthorn and yucca readily invade the unit as the plant community deteriorates.

Deferment from grazing during the growing season is needed to maintain or improve the vigor and reproduction of desirable forage plants such as black grama. Rangeland seeding is not suitable because of the low precipitation. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage. This unit has limited suitability for livestock watering ponds and other water impoundments because of the seepage potential and the shallow depth of the Blakeney soil.

The average annual production of air-dry vegetation on this unit ranges from 800 pounds per acre in favorable years to 300 pounds in unfavorable years.

BRB—Blakeney-Ratliff association, moderately undulating. This map unit is on high terraces in the eastern part of the survey area. Slope is 0 to 5 percent. Areas are rectangular or irregular in shape and are 50 to 3,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,800 to 4,000 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 195 to 205 days.

This unit is 45 percent Blakeney fine sandy loam, 0 to 5 percent slopes, and 45 percent Ratliff fine sandy loam, 0 to 2 percent slopes. The Blakeney soil is on ridges, and the Ratliff soil is in depressional areas.

Included in this unit are small areas of Philder and Sharvana soils on ridges, Redona soils in depressional areas, and a soil that is 20 to 40 inches deep to indurated caliche and is on ridges and in depressional areas. Included areas make up about 10 percent of the total acreage.

The Blakeney soil is shallow and well drained. It formed in calcareous alluvial and eolian deposits. Typically, the surface layer is brown fine sandy loam about 6 inches thick. The subsoil is brown fine sandy loam about 7 inches thick. Indurated caliche is at a depth of 13 inches.

Permeability of the Blakeney soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 8 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Ratliff soil is deep and well drained. It formed in calcareous alluvium derived dominantly from loamy calcareous material. Typically, the surface layer is reddish brown fine sandy loam about 6 inches thick. The subsoil is 54 inches thick. The upper 30 inches of the subsoil is reddish brown and light reddish brown sandy clay loam, and the lower 24 inches is white sandy clay loam.

Permeability of the Ratliff soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Blakeney soil is mainly blue grama, black grama, hairy grama, and small soapweed. The potential plant community on the Ratliff soil is mainly black grama, little bluestem, plains bristlegass, and yucca. As the plant community deteriorates, the more palatable and desirable forage plants such as black grama decrease and there is an increase in plants such as sand dropseed, threeawn, and broom snakeweed, which normally occur only in small amounts. Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as black grama and little bluestem. Mesquite readily invades the unit as the plant community deteriorates.

This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential and the shallow depth of the Blakeney soil. Areas that are heavily infested with undesirable plants can be improved by chemical treatment.

The average annual production of air-dry vegetation on this unit ranges from 1,500 pounds per acre in favorable years to 600 pounds in unfavorable years.

CMB—Chispa-Malstrom association, moderately undulating. This map unit is on high terraces in the eastern part of the survey area. Slope is 0 to 4 percent. Areas are elongated or irregular in shape and are 200 to 1,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,800 to 4,000 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 195 to 205 days.

This unit is 45 percent Chispa fine sandy loam, 0 to 2 percent slopes, and 40 percent Malstrom loamy fine sand, 0 to 4 percent slopes. The Chispa soil is in depressional areas, and the Malstrom soil is on low ridges.

Included in this unit are small areas of Faskin, Jalmar, Pyote, and Roswell soils on low ridges and side slopes. Also included are areas of clayey soils in depressional and low-lying areas. Included areas make up about 15 percent of the total acreage.

The Chispa soil is deep and well drained. It formed in calcareous alluvial and lacustrine sediment. Typically, the surface layer is brown fine sandy loam about 5 inches thick. The subsoil is 27 inches thick. The upper 10 inches of the subsoil is reddish brown sandy clay loam, and the lower 17 inches is light brown and light brownish gray clay loam. The upper 21 inches of the substratum is very pale brown clay loam, and the lower part to a depth of 60 inches or more is very pale brown loam.

Permeability of the Chispa soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Malstrom soil is deep and well drained. It formed in calcareous alluvial and eolian deposits. Typically, the surface layer is brown loamy fine sand about 4 inches thick. The subsoil is light brown loamy fine sand about 10 inches thick. The upper 12 inches of the substratum is brown fine sandy loam, the next 20 inches is pink loam, and the lower part to a depth of 60 inches or more is pink fine sandy loam.

Permeability of the Malstrom soil is moderately rapid. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is very high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Chispa soil is mainly black grama, blue grama, sideoats grama, and small soapweed. As the plant community deteriorates, the more palatable and desirable forage plants such as black grama and sideoats grama decrease and there is

an increase in plants such as burrograss and fluffgrass, which normally occur only in small amounts. Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as sideoats grama and sand bluestem.

The average annual production of air-dry vegetation on this soil ranges from 1,400 pounds per acre in favorable years to 500 pounds in unfavorable years.

The potential plant community on the Malstrom soil is mainly sand bluestem, little bluestem, sideoats grama, and plains bristlegrass. As the plant community deteriorates, the more palatable and desirable forage plants such as sand bluestem and little bluestem decrease and there is an increase in plants such as red threeawn, sand dropseed, and broom snakeweed, which normally occur only in small amounts. Mesquite and shinnery oak readily invade.

The average annual production of air-dry vegetation on this soil ranges from 3,000 pounds per acre in favorable years to 1,500 pounds in unfavorable years.

Rangeland seeding is not suitable on this unit because of the low precipitation. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

CRB—Conger-Reagan association, moderately undulating. This map unit is on uplands in the western part of the survey area. Slope is 0 to 5 percent. Areas are irregular in shape and are 800 to 3,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,300 to 4,700 feet. The average annual precipitation is about 13 to 14 inches, the average annual air temperature is about 58 to 60 degrees F, and the average frost-free period is 190 to 200 days.

This unit is 60 percent Conger loam, 0 to 5 percent slopes, and 25 percent Reagan silt loam, 0 to 2 percent slopes. The Conger soil is on knolls and ridges, and the Reagan soil is on alluvial side slopes and in depressional areas.

Included in this unit are small areas of Ector soils on ridges and Ranstein soils in depressional areas. Included areas make up about 15 percent of the total acreage.

The Conger soil is shallow and well drained. It formed in calcareous alluvium. Typically, the surface layer is brown loam about 3 inches thick. The subsoil is brown cobbly silt loam about 9 inches thick. Indurated caliche is at a depth of 12 inches.

Permeability of the Conger soil is moderate. Available water capacity is very low. Effective rooting depth is 8 to 20 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is high.

The Reagan soil is deep and well drained. It formed in calcareous alluvium derived dominantly from limestone. Typically, the surface layer is brown silt loam and yellowish brown silty clay loam about 10 inches thick.

The subsoil is 32 inches thick. The upper 15 inches of the subsoil is brown and light brown silty clay loam, and the lower 17 inches is pink silty clay loam. The substratum to a depth of 60 inches or more is pink silty clay loam.

Permeability of the Reagan soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Conger soil is mainly black grama, sideoats grama, blue grama, and New Mexico feathergrass. The present vegetation in most areas is mainly sand dropseed, tobosa, poverty threeawn, and wolftail. This soil also supports important forage plants such as Mormon-tea and yucca. Use of livestock watering ponds and other water impoundments is limited because of the shallow depth.

The average annual production of air-dry vegetation on this soil ranges from 1,200 pounds per acre in favorable years to 400 pounds in unfavorable years.

The potential plant community on the Reagan soil is mainly blue grama, tobosa, black grama, and silver bluestem. This soil also supports important forage plants such as winterfat and western wheatgrass. Mesquite readily invades the soil. Rangeland seeding is suitable but is limited because of the low precipitation.

The average annual production of air-dry vegetation on this soil ranges from 1,600 pounds per acre in favorable years to 700 pounds in unfavorable years.

DaA—Darvey loam, 0 to 2 percent slopes. This deep, well drained soil is on alluvial side slopes, alluvial fans, and valley floors in the northwestern part of the survey area. It formed in calcareous alluvium derived dominantly from limestone. Slope is 0 to 2 percent. Areas are irregular in shape and are 500 to 3,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,000 to 4,600 feet. The average annual precipitation is 14 to 15 inches, the average annual air temperature is 54 to 56 degrees F, and the average frost-free period is 180 to 190 days.

Typically, the surface layer is brown loam about 4 inches thick. The subsoil is 24 inches thick. The upper 12 inches of the subsoil is brown loam, and the lower 12 inches is yellowish brown clay loam. The substratum to a depth of 60 inches or more is white and very pale brown clay loam.

Included in this unit are small areas of Deama and Pastura soils on knolls and alluvial side slopes, Threadgill and Asparas soils in depressional areas, and soils that are less than 20 inches deep, have layers high in content of calcium carbonate, and are on low ridges and upper side slopes. Included areas make up about 20 percent of the total acreage.

Permeability of the Darvey soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly blue grama, western wheatgrass, sideoats grama, and vine-mesquite. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Plants in the potential plant community that increase because of overgrazing are threeawn, broom snakeweed, and tobosa. Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as sideoats grama and western wheatgrass.

The average annual production of air-dry vegetation on this unit ranges from 1,100 pounds per acre in favorable years to 500 pounds in unfavorable years.

DDC—Deama-Darvey-Rock outcrop association, moderately rolling. This map unit is on ridges, knolls, and alluvial side slopes on plateaus in the northwestern part of the survey area. Slope is 1 to 15 percent. Areas are irregular in shape and are 450 to 8,500 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,400 to 5,000 feet. The average annual precipitation is 14 to 15 inches, the average annual air temperature is 54 to 56 degrees F, and the average frost-free period is about 180 to 190 days.

This unit is 40 percent Deama gravelly loam, 1 to 15 percent slopes; 20 percent Darvey loam, 1 to 5 percent slopes; and 15 percent Rock outcrop. The Deama soil is on knolls and ridges, the Darvey soil is on alluvial side slopes, and Rock outcrop is intermingled with areas of the Deama soil.

Included in this unit are small areas of Pastura soils on knolls and ridges, soils that are moderately deep to limestone and are on knolls and ridges, and deep, dark-colored soils in depressional areas. Included areas make up about 25 percent of the total acreage.

The Deama soil is shallow and well drained. It formed in residuum derived dominantly from limestone. Typically, the surface layer is brown gravelly loam about 5 inches thick. The substratum is brown extremely cobbly loam about 5 inches thick over limestone.

Permeability of the Deama soil is moderate. Available water capacity is very low. Effective rooting depth is 7 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

The Darvey soil is deep and well drained. It formed in calcareous alluvium derived dominantly from limestone. Typically, the surface layer is brown loam about 6 inches

thick. The subsoil is 24 inches thick. The upper 7 inches of the subsoil is brown loam, and the lower 17 inches is light brown clay loam. The substratum to a depth of 60 inches or more is reddish brown clay loam.

Permeability of the Darvey soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

Rock outcrop is exposed areas of unweathered limestone. It supports little if any vegetation. Surface runoff is rapid.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Deama soil is mainly sideoats grama, New Mexico feathergrass, black grama, and plains lovegrass. Oneseed juniper is scattered throughout the plant community. The potential plant community on the Darvey soil is mainly blue grama, sideoats grama, black grama, and tobosa. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Plants in the potential plant community that increase because of overgrazing are threeawn, ring muhly, and broom snakeweed.

Rangeland seeding is suitable on the Darvey soil but is limited because of the low precipitation. Slope limits access by livestock and encourages overgrazing of the less sloping areas. Rangeland improvement practices such as livestock water pipelines, fences, and water impoundment facilities are difficult to install on the Deama soil because of the shallow depth to limestone.

The average annual production of air-dry vegetation on this unit ranges from 1,100 pounds per acre in favorable years to 300 pounds in unfavorable years.

DPC—Deama-Pastura association, moderately rolling. This map unit is on uplands in the northwestern part of the survey area. Slope is 0 to 15 percent. Areas are irregular in shape and are 1,000 to 4,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,400 to 4,900 feet. The average annual precipitation is 14 to 15 inches, the average annual air temperature is 54 to 56 degrees F, and the average frost-free period is 180 to 190 days.

This unit is 40 percent Deama gravelly loam, 3 to 15 percent slopes, and 30 percent Pastura loam, 0 to 5 percent slopes. The Deama soil is on back slopes, and the Pastura soil is on ridges and foot slopes.

Included in this unit are areas of very cobbly Deama soils that have slopes of 15 to 30 percent, Asparas and Gabaldon soils on valley bottoms, gently sloping Darvey soils, and a soil that is similar to the Deama soil but does not have a dark-colored surface layer. Also

included are small areas of soils in which the indurated caliche layer overlies limestone. Included areas make up about 30 percent of the total acreage; of this, the included Deama soils make up about 15 percent.

The Deama soil is shallow and well drained. It formed in residuum derived dominantly from limestone. Typically, the surface layer is dark grayish brown gravelly loam and very cobbly loam about 8 inches thick. The substratum is dark brown very cobbly loam about 4 inches thick over limestone.

Permeability of the Deama soil is moderate. Available water capacity is very low. Effective rooting depth is 7 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

The Pastura soil is shallow and well drained. It formed in calcareous alluvium mixed with eolian material. Typically, the surface layer is brown loam about 9 inches thick. The substratum is light yellowish brown loam about 4 inches thick over indurated caliche.

Permeability of the Pastura soil is moderate. Available water capacity is very low. Effective rooting depth is 7 to 20 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly sideoats grama, New Mexico feathergrass, plains lovegrass, and black grama. As the plant community deteriorates, the more palatable and desirable forage plants such as sideoats grama, New Mexico feathergrass, and black grama decrease and there is an increase in plants such as threeawn, broom snakeweed, and ring muhly, which normally occur only in small amounts. Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as sideoats grama, New Mexico feathergrass, and black grama.

The unit is not suited to rangeland improvement practices such as livestock water pipelines, fences, and water impoundment facilities because of the shallow depth to limestone and caliche. Mechanical treatment is not practical because of the stony surface and the steepness of slope.

The average annual production of air-dry vegetation on this unit ranges from 1,100 pounds per acre in favorable years to 300 pounds in unfavorable years.

DRD—Deama-Rock outcrop-Threadgill complex, hilly. This map unit is on dissected uplands in the northwestern part of the survey area. Slope is 0 to 30 percent. Areas are irregular in shape and are 300 to 1,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,400 to 4,700 feet. The average annual precipitation is 14 to 15 inches, the average annual air temperature is 54 to 56 degrees F, and the average frost-free period is about 180 to 190 days.

This unit is 50 percent Deama very gravelly loam, 5 to 30 percent slopes; 20 percent Rock outcrop; and 15 percent Threadgill silt loam, 0 to 5 percent slopes. The Deama soil is on limestone ridges and back slopes, Rock outcrop is on back slopes and ridge shoulder slopes, and the Threadgill soil is in drainageways and on foot slopes.

Included in this unit are small areas of Pastura soils on ridgetops and foot slopes; deep, dark-colored soils in drainageways and on foot slopes; and soils that are more than 20 inches deep to limestone. Included areas make up about 15 percent of the total acreage.

The Deama soil is shallow and well drained. It formed in residuum derived dominantly from limestone. Typically, the surface layer is brown very gravelly loam about 3 inches thick. The subsoil is brown extremely cobbly loam about 4 inches thick. Limestone is at a depth of 7 inches.

Permeability of the Deama soil is moderate. Available water capacity is very low. Effective rooting depth is 7 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

Rock outcrop is areas of exposed limestone. These areas support little if any vegetation. Surface runoff is rapid.

The Threadgill soil is deep and well drained. It formed in calcareous alluvium derived dominantly from limestone. Typically, the surface layer is dark yellowish brown silt loam about 4 inches thick. The subsoil is 20 inches thick. The upper 15 inches of the subsoil is dark yellowish brown and brown silty clay loam, and the lower 5 inches is light brown silty clay loam. The substratum to a depth of 60 inches or more is light brown and pink silty clay loam.

Permeability of the Threadgill soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Deama soil is mainly sideoats grama, New Mexico feathergrass, black grama, and plains lovegrass. The potential plant community on the Threadgill soil is mainly western wheatgrass, vine-mesquite, blue grama, and little bluestem. Plants in the potential plant community that increase because of overgrazing are threeawn, broom snakeweed, and ring muhly. Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as sideoats grama, New Mexico feathergrass, and blue grama. The Deama soil is not suited to rangeland improvement practices such as livestock water pipelines, fences, and water impoundment facilities because of the shallow depth to limestone.

The average annual production of air-dry vegetation on this unit ranges from 1,100 pounds per acre in favorable years to 300 pounds in unfavorable years.

DsA—Dona Ana sandy loam. This deep, well drained soil is on low terraces in the south-central part of the survey area. It formed in alluvium derived dominantly from loamy, calcareous material. Slope is 0 to 1 percent. Areas are irregular in shape and are 200 to 1,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,650 to 3,800 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

Typically, the surface layer is reddish brown sandy loam about 6 inches thick. The subsoil is 46 inches thick. The upper 36 inches of the subsoil is light reddish brown clay loam, and the lower 10 inches is reddish yellow fine sandy loam. The substratum to a depth of 60 inches or more is reddish yellow loamy fine sand.

Included in this unit are small areas of Bluepoint soils on coppice dunes, Hollomex soils scattered throughout the unit, and clayey soils in depressional areas. Included areas make up about 20 percent of the total acreage.

Permeability of this unit is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly black grama, mesa dropseed, blue grama, and plains bristlegass. As the plant community deteriorates, the more palatable and desirable forage plants such as black grama and mesa dropseed decrease and there is an increase in plants such as poverty threeawn, burrograss, broom snakeweed, small soapweed, and sand sagebrush, which normally occur only in small amounts. Mesquite readily invades the unit as the plant community deteriorates.

Rangeland seeding is not suitable because of the low precipitation. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage. This unit has limited suitability for livestock watering ponds and other water impoundments because of the seepage potential.

The average annual production of air-dry vegetation on this unit ranges from 1,100 pounds per acre in favorable years to 600 pounds in unfavorable years.

DUA—Douro-Faskin, moist association, gently undulating. This map unit is on high plains in the eastern part of the survey area. Slope is 0 to 2 percent. Areas are irregular or oblong in shape and are 200 to 1,000 acres in size. The native vegetation is mainly

grasses and shrubs. Elevation is 4,400 to 4,500 feet. The average annual precipitation is 14 to 15 inches, the average annual air temperature is 58 to 60 degrees F, and the average frost-free period is 185 to 195 days.

This unit is 50 percent Douro fine sandy loam, 0 to 2 percent slopes, and 40 percent Faskin fine sandy loam, 0 to 1 percent slopes, moist. The Douro soil is on low ridges, and the Faskin soil is in depressional areas.

Included in this unit are small areas of Portales soils and a soil that has a high calcium carbonate content above a depth of 20 inches and is in depressional areas. Also included are areas of a sandy soil that is less than 20 inches deep to indurated caliche and is on low ridges. Included areas make up about 10 percent of the total acreage.

The Douro soil is moderately deep and well drained. It formed in calcareous alluvial and eolian deposits. Typically, the surface layer is brown fine sandy loam about 8 inches thick. The subsoil is reddish brown sandy clay loam about 17 inches thick. Indurated caliche is at a depth of 25 inches.

Permeability of the Douro soil is moderate. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Faskin soil is deep and well drained. It formed in calcareous alluvial and eolian deposits. Typically, the surface layer is brown and reddish brown fine sandy loam about 12 inches thick. The subsoil is 48 inches thick. The upper 18 inches of the subsoil is reddish brown sandy clay loam, and the lower 30 inches is pink and light reddish brown sandy clay loam.

Permeability of the Faskin soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly little bluestem, black grama, blue grama, and small soapweed. Plants in the potential plant community that increase because of overgrazing are buffalograss and catclaw acacia. Mesquite, shinnery oak, and sand sagebrush readily invade the unit as the plant community deteriorates.

Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as black grama and little bluestem. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Rangeland seeding is a suitable practice.

The average annual production of air-dry vegetation on this unit ranges from 1,500 pounds per acre in favorable years to 800 pounds in unfavorable years.

EaC—Ector very cobbly loam, 3 to 15 percent slopes. This shallow, well drained soil is on uplands in the western part of the survey area (fig. 1). It formed in residuum derived dominantly from limestone. Areas are irregular or elongated in shape and are 500 to 3,500 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,300 to 4,700 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 58 to 60 degrees F, and the average frost-free period is about 190 to 200 days.

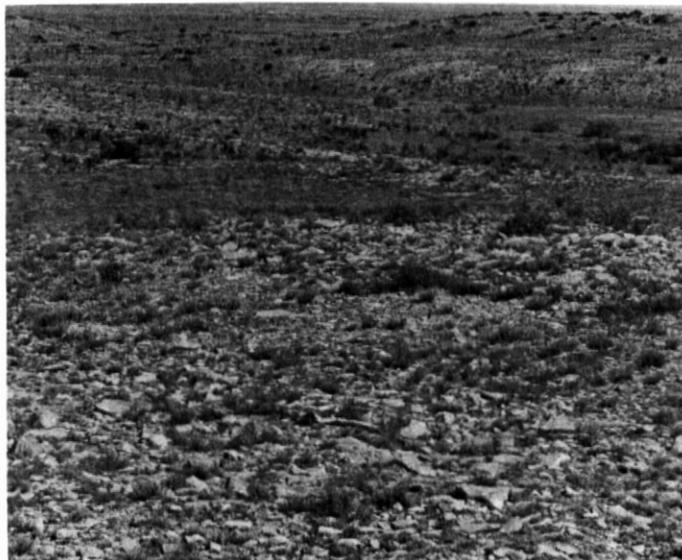


Figure 1.—Area of Ector very cobbly loam, 3 to 15 percent slopes, in foreground.

Typically, the surface layer is dark grayish brown and dark brown very cobbly loam about 9 inches thick. Limestone is at a depth of 9 inches.

Included in this unit are small areas of Ranstein and Reagan soils in valleys and depressional areas, Conger soils on broad ridgetops and toe slopes, and Rock outcrop. Included areas make up about 25 percent of the total acreage.

Permeability of the Ector soil is moderate. Available water capacity is very low. Effective rooting depth is 7 to 20 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is slight.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly Metcalfe muhly, New Mexico feathergrass, sideoats grama, and black grama. The present vegetation in most areas is mainly Metcalfe muhly, hairy grama, wolftail, and broom snakeweed. The unit can support scattered juniper. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired

balance of preferred species is maintained in the plant community.

Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as New Mexico feathergrass and sideoats grama. Trails or walkways can be constructed in places to encourage livestock to graze in areas where access is limited. Mechanical treatment is not practical because of the very cobbly surface and the rolling slopes. Rangeland seeding is not suitable because of the shallow soil depth and low precipitation. The total plant growth is barely adequate during normal years to protect the soil surface from erosion; therefore, a suitable grazing management program is to graze this unit only for short periods in fall following seasons of above normal production. The unit is not suited to rangeland improvement practices such as livestock water pipelines, fences, and water impoundment facilities because of the shallow depth to limestone.

The average annual production of air-dry vegetation on this unit ranges from 950 pounds per acre in favorable years to 350 pounds in unfavorable years.

EbC—Ector very cobbly loam, dry, 3 to 15 percent slopes. This shallow, well drained soil is on uplands in the south-central part of the survey area. It formed in residuum derived dominantly from limestone. Areas are irregularly rounded or elongated in shape and are 100 to 3,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,700 to 4,300 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

Typically, the surface layer is dark brown very cobbly loam about 10 inches thick. The substratum is brown extremely cobbly loam about 5 inches thick. Limestone is at a depth of 15 inches.

Included in this unit are small areas of extremely cobbly Ector soils; Conger soils on alluvial fans; deep, dark-colored soils in valleys; Reakor soils on alluvial side slopes and in valleys; and Rock outcrop. Also included are small areas of soils that have slopes of more than 15 percent. Included areas make up about 25 percent of the total acreage.

Permeability of the Ector soil is moderate. Available water capacity is very low. Effective rooting depth is 7 to 20 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is slight.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly black grama, sideoats grama, hairy grama, and creosotebush. The present vegetation in most areas is mainly hairy grama, hairy tridens, fluffgrass, and creosotebush. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases.

Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Plants occurring in the potential plant community that increase because of overgrazing are creosotebush and fluffgrass.

Mechanical treatment is not practical because of the very cobbly surface and the rolling slopes. The total plant growth is barely adequate during normal years to protect the soil surface from erosion; therefore, a suitable grazing management program is to graze this unit only for short periods in fall following seasons of above normal production. Rangeland improvement practices such as livestock water pipelines, fences, and water impoundment facilities are difficult to install because of the shallow depth to limestone.

The average annual production of air-dry vegetation on this unit ranges from 950 pounds per acre in favorable years to 350 pounds in unfavorable years.

ECC—Ector-Conger association, moderately rolling. This map unit is on back slopes, knolls, and ridges of uplands in the southwestern part of the survey area. Slope is 0 to 15 percent. Areas are irregular or elongated in shape and are 500 to 2,500 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,300 to 4,700 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is about 58 to 60 degrees F, and the average frost-free period is about 190 to 200 days.

This unit is 45 percent Ector very cobbly loam, 3 to 15 percent slopes, and 40 percent Conger loam, 0 to 5 percent slopes. The Ector soil is on back slopes and narrow ridges, and the Conger soil is on knolls and ridges.

Included in this unit are small areas of Reagan and Hodgins soils on alluvial fans and in depressional areas, Ranstein soils in drainageways and depressional areas, shallow soils in which indurated caliche overlies limestone, and Rock outcrop. Included areas make up about 15 percent of the total acreage.

The Ector soil is shallow and well drained. It formed in residuum derived dominantly from limestone. Typically, the surface layer is dark brown very cobbly loam about 9 inches thick. The substratum is dark yellowish brown extremely cobbly loam about 3 inches thick. Limestone is at a depth of 12 inches.

Permeability of the Ector soil is moderate. Available water capacity is very low. Effective rooting depth is 7 to 20 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is slight.

The Conger soil is shallow and well drained. It formed in calcareous alluvium. Typically, the surface layer is brown loam about 5 inches thick. The subsoil is brown and light brown clay loam about 12 inches thick. Indurated caliche is at a depth of 17 inches.

Permeability of the Conger soil is moderate. Available water capacity is very low. Effective rooting depth is 8 to

20 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly black grama, sideoats grama, New Mexico feathergrass, and Metcalfe muhly. The present vegetation in most areas is mainly hairy grama, wolftail, Metcalfe muhly, and broom snakeweed. The Ector soil can support scattered juniper. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Walkingstick cholla readily invades the unit as the plant community deteriorates.

Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as New Mexico feathergrass and black grama. Trails or walkways can be constructed in places to encourage livestock to graze in areas where access is limited. Mechanical treatment is not practical because of the very cobbly surface and the rolling slopes. Rangeland seeding is not suitable because of shallow soil depth and low precipitation. This unit is not suited to rangeland improvement practices such as water impoundment facilities, fences, and livestock water pipelines because of the shallow depth to limestone and caliche.

The average annual production of air-dry vegetation on this unit ranges from 700 pounds per acre in favorable years to 450 pounds in unfavorable years.

ERD—Ector-Rock outcrop complex, hilly. This map unit is on hills, ridges, and breaks in the southwestern part of the survey area. Slope is 15 to 30 percent. Areas are irregular or elongated in shape and are 200 to 1,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,200 to 4,600 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 58 to 60 degrees F, and the average frost-free period is about 190 to 200 days.

This unit is 65 percent Ector extremely cobbly loam, 15 to 30 percent slopes, and 20 percent Rock outcrop. The Ector soil is on hills and ridges, and Rock outcrop is on side slopes, ridge shoulders, and breaks.

Included in this unit are small areas of Reagan soils on alluvial fans and in narrow drainageways. Also included are small areas of Conger soils on alluvial fans and at the base of limestone ridges. Included areas make up about 15 percent of the total acreage.

The Ector soil is shallow and well drained. It formed in residuum derived dominantly from limestone. Typically, the surface layer is brown extremely cobbly loam about 11 inches thick. The substratum is brown extremely

cobbly loam about 6 inches thick. Limestone is at a depth of 17 inches.

Permeability of the Ector soil is moderate. Available water capacity is very low. Effective rooting depth is 7 to 20 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is slight.

Rock outcrop is exposed areas of unweathered limestone. It supports little if any vegetation. Surface runoff is rapid.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Ector soil is mainly black grama, sideoats grama, hairy grama, and blue grama. The present vegetation in most areas is mainly hairy grama, hairy tridens, poverty threeawn, and curlyleaf muhly. Rangeland improvement practices such as livestock water pipelines, fences, and water impoundment facilities are difficult to install because of the shallow depth to limestone. Rangeland seeding is not suitable because of the shallow soil depth and the low precipitation. Steepness of slope limits access by livestock and encourages overgrazing of the less sloping areas.

The average annual production of air-dry vegetation on the Ector soil ranges from 500 pounds per acre in favorable years to 250 pounds in unfavorable years.

ESD—Ector-Rock outcrop complex, dry, hilly. This map unit is on uplands in the south-central part of the survey area. Slope is 15 to 30 percent. Areas are irregularly rounded or elongated in shape and are 200 to 4,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,700 to 4,300 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

This unit is 65 percent Ector extremely cobbly loam, dry, 15 to 30 percent slopes, and 20 percent Rock outcrop. The Ector soil is on low hills and ridges, and Rock outcrop is on ridge shoulders and escarpments.

Included in this unit are small areas of Reakor soils on alluvial fans, Upton soils on ridges and alluvial fans, and a deep, dark-colored soil in narrow drainageways. Also included are small areas of Ector soils that have slopes of less than 15 percent. Included areas make up about 15 percent of the total acreage.

The Ector soil is shallow and well drained. It formed in residuum derived dominantly from limestone. Typically, the surface layer is grayish brown extremely cobbly loam about 14 inches thick. Limestone is at a depth of 14 inches.

Permeability of the Ector soil is moderate. Available water capacity is very low. Effective rooting depth is 7 to 20 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is slight.

Rock outcrop is areas of exposed limestone. It supports little if any vegetation. Surface runoff is rapid.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Ector soil is mainly black grama, sideoats grama, hairy grama, and creosotebush. The present vegetation in most areas is mainly hairy grama, hairy tridens, fluffgrass, and creosotebush. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Plants in the potential plant community that increase because of overgrazing are creosotebush and fluffgrass.

Steepness of slope limits access by livestock and encourages overgrazing of the less sloping areas. Mechanical treatment is not practical because of the extremely cobbly surface and the hilly slopes. Loss of the surface layer results in a severe decrease in productivity and in the potential of the soil to produce forage. The total plant growth is barely adequate during normal years to protect the soil surface from erosion; therefore, a suitable grazing management program is to graze the unit only for short periods in fall following seasons of above normal production. Rangeland improvement practices such as livestock water pipelines, fences, and water impoundment facilities are difficult to install because of the shallow depth to limestone.

The average annual production of air-dry vegetation on the Ector soil ranges from 950 pounds per acre in favorable years to 350 pounds in unfavorable years.

FaA—Faskin fine sand, 0 to 2 percent slopes. This deep, well drained soil is on high terraces in the eastern part of the survey area. It formed in alluvial and eolian deposits. Areas are irregular in shape and are 100 to 2,000 acres in size. The native vegetation is mainly grasses and shrubs (fig. 2). Elevation is 3,800 to 4,200 feet. The average annual precipitation is about 13 to 14 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 195 to 205 days.

Typically, the surface layer is yellowish brown fine sand about 14 inches thick. The subsoil is brown, light reddish brown, and pink sandy clay loam about 42 inches thick. The substratum to a depth of 60 inches or more is pinkish white loam.

Included in this unit are small areas of Jalmar soils that are intermingled with the Faskin soil, Roswell soils on scattered dunes, and a soil that is moderately deep to indurated caliche. Included areas make up about 15 percent of the total acreage.

Permeability of the Faskin soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is very high.



Figure 2.— Area of Faskin fine sand, 0 to 2 percent slopes.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly sand bluestem, little bluestem, sand dropseed, and plains bristlegrass. The present vegetation in most areas is mainly sand dropseed, black grama, poverty threeawn, and shinnery oak. Plants in the potential plant community that increase because of overgrazing are shinnery oak, sand sagebrush, and small soapweed. Further deterioration results in the total domination of the plant community by shinnery oak and mesquite, with very little production of grass. In areas where shinnery oak is dominant, livestock should be removed when the shinnery oak is in late bud or early leaf stage because of its toxicity during this period.

Deferment from grazing during the growing season is needed to maintain or improve the vigor and reproduction of desirable forage plants such as sand bluestem and little bluestem. Rangeland seeding is not suitable because of the low precipitation. Mechanical

brush control and mechanical treatment are not suitable because of the risk of soil blowing.

The average annual production of air-dry vegetation on this unit ranges from 3,000 pounds per acre in favorable years to 1,500 pounds in unfavorable years.

FMA—Faskin-Malstrom association, gently undulating. This map unit is on high terraces in the eastern part of the survey area. Slope is 0 to 2 percent. Areas are irregular in shape and are 500 to 2,000 acres in size. The native vegetation is mainly grasses and shrubs (fig. 3). Elevation is 3,900 to 4,100 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 195 to 205 days.

This unit is 50 percent Faskin loamy fine sand, 0 to 2 percent slopes, and 40 percent Malstrom loamy fine sand, 0 to 2 percent slopes.

Included in this unit are small areas of Jalmar and Pyote soils that have a thick fine sand and loamy fine sand surface layer, Roswell soils in areas of dunes, and

Stromal soils. Included areas make up about 10 percent of the total acreage.

The Faskin soil is deep and well drained. It formed in alluvial and eolian deposits. Typically, the surface layer is brown loamy fine sand about 9 inches thick. The subsoil is 41 inches thick. The upper 9 inches of the subsoil is red fine sandy loam, and the lower 32 inches is red sandy clay loam. The substratum to a depth of 60 inches or more is pink sandy clay loam.

Permeability of the Faskin soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is very high.

The Malstrom soil is deep and well drained. It formed in calcareous alluvial and eolian deposits. Typically, the surface layer is brown loamy fine sand about 8 inches

thick. The subsoil is brown loamy fine sand about 16 inches thick. The substratum to a depth of 60 inches or more is light yellowish brown and brown fine sandy loam.

Permeability of the Malstrom soil is moderately rapid. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is very high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly sand bluestem, little bluestem, sand dropseed, and small soapweed. The present vegetation in most areas is mainly small soapweed, sand dropseed, sand sagebrush, and shinnery oak. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases.

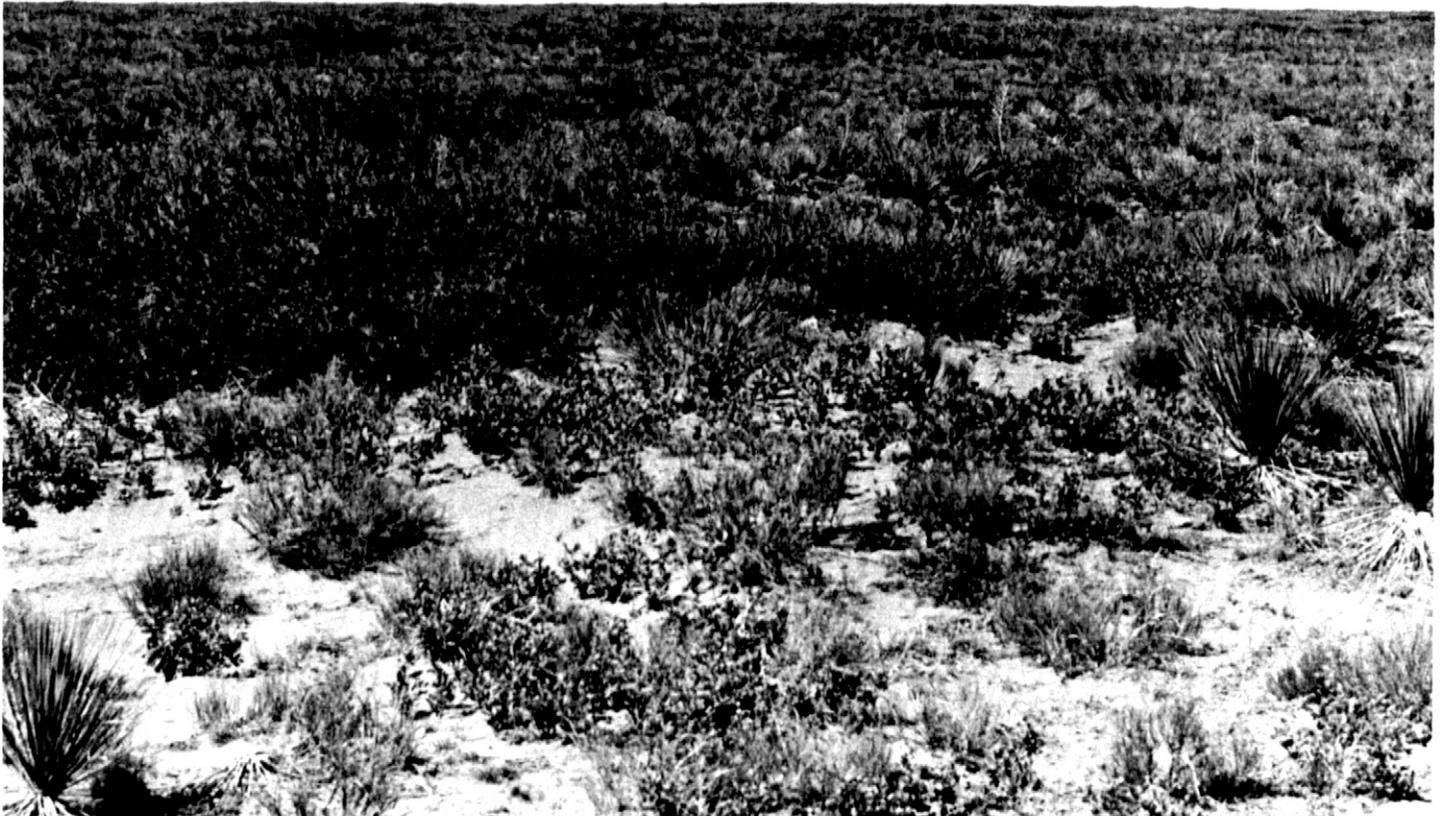


Figure 3.—Area of Faskin-Malstrom association, gently undulating.

Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Mesquite and shinnery oak readily invade this unit as the plant community deteriorates. Further deterioration results in a total domination of the plant community by shinnery oak, with very little production of grass. In areas where shinnery oak is dominant, livestock should be removed when the shinnery oak is in late bud or early leaf stage because of its toxicity to livestock during this period.

Rangeland seeding is suitable on this unit. Rangeland improvement practices such as water impoundment facilities have limited suitability because of low runoff and seepage.

The average annual production of air-dry vegetation on this unit ranges from 3,000 pounds per acre in favorable years to 1,500 pounds in unfavorable years.

FRB—Faskin-Roswell complex, hummocky. This map unit is on high terraces in the eastern part of the survey area. Slope is 0 to 5 percent. Areas are irregular in shape and are 200 to 1,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,800 to 4,100 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 195 to 205 days.

This unit is 55 percent Faskin sandy clay loam, eroded, 0 to 2 percent slopes, and 40 percent Roswell loamy fine sand, 2 to 5 percent slopes. The Faskin soil is in interdunal areas, and the Roswell soil is on coppice dunes.

Included in this unit are small areas of Faskin loamy fine sand in noneroded areas and Malstrom soils in eroded interdunal areas. Included areas make up about 5 percent of the total acreage.

The Faskin soil is deep and well drained. It formed in alluvial and eolian deposits. Typically, the original surface layer has been lost through erosion. The upper part of the subsoil is reddish brown sandy clay loam about 16 inches thick, and the lower part is yellowish red sandy clay loam about 24 inches thick. The substratum to a depth of 60 inches or more is pink sandy clay loam.

Permeability of the Faskin soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Roswell soil is deep and excessively drained. It formed in eolian deposits. Typically, the surface layer is brown loamy fine sand about 6 inches thick. The substratum to a depth of 60 inches or more is brown loamy fine sand.

Permeability of the Roswell soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly sand bluestem, little bluestem, plains bristlegrass, and sand paspalum. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Plants in the potential plant community that increase because of overgrazing are poverty threeweed, small soapweed, sand sagebrush, and shinnery oak. Mesquite readily invades the Roswell soil. Further deterioration results in a total domination of the plant community by shinnery oak and mesquite, with very little production of grass.

Deferment from grazing during the growing season is needed to maintain and improve the vigor and reproduction of sand bluestem and little bluestem. Rangeland seeding is not suitable because of the low precipitation. Livestock grazing should be managed to protect the unit from excessive erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce plants suitable for grazing. If the plant cover is disturbed, protection is needed to control gullying, streambank cutting, and sheet erosion. The unit has limited suitability for livestock watering ponds and other water impoundments because of the seepage potential.

The average annual production of air-dry vegetation on this unit ranges from 3,000 pounds per acre in favorable years to 1,500 pounds in unfavorable years.

FSA—Faskin, moist-Douro association, gently undulating. This map unit is on high plains in the eastern part of the survey area. Slope is 0 to 2 percent. Areas are irregular in shape and are 600 to 5,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,400 to 4,500 feet. The average annual precipitation is 14 to 15 inches, the average annual air temperature is 58 to 60 degrees F, and the average frost-free period is 185 to 195 days.

This unit is 60 percent Faskin loamy fine sand, 0 to 1 percent slopes, moist, and 30 percent Douro loamy fine sand, 0 to 2 percent slopes. The Faskin soil is in depressional areas, and the Douro soil is on low ridges.

Included in this unit are small areas of Jalmar soils in depressional areas; a sandy, highly calcareous soil in depressional areas; a soil that is less than 20 inches deep to indurated caliche and is on ridges; a soil that is 40 to 60 inches deep to caliche and is in depressional areas; and moderately rolling Nutivoli soils in areas of dunes. Included areas make up about 10 percent of the total acreage.

The Faskin soil is deep and well drained. It formed in alluvial and eolian deposits. Typically, the surface layer is brown loamy fine sand about 7 inches thick. The subsoil

is 53 inches thick. The upper 29 inches of the subsoil is reddish brown and yellowish red sandy clay loam, and the lower 24 inches is white sandy clay loam.

Permeability of the Faskin soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is very high.

The Douro soil is moderately deep and well drained. It formed in calcareous alluvial and eolian deposits.

Typically, the surface layer is reddish brown loamy fine sand and fine sandy loam about 11 inches thick. The subsoil is yellowish red sandy clay loam about 22 inches thick. Indurated caliche is at a depth of 33 inches.

Permeability of the Douro soil is moderate. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is very high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly little bluestem, sideoats grama, plains lovegrass, and Hall panicum. The present vegetation in most areas is mainly sand bluestem, red lovegrass, sand dropseed, and small soapweed. Grazing management should be designed to increase the vigor and productivity of little bluestem and sideoats grama. Plants in the potential plant community that increase because of overgrazing are blue grama, small soapweed, and sand sagebrush. Shinnery oak readily invades this unit as the plant community deteriorates. Rangeland seeding is suitable. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage.

The average annual production of air-dry vegetation on this unit ranges from 2,700 pounds per acre in favorable years to 1,200 pounds in unfavorable years.

GaC—Gallen very gravelly loam, 2 to 15 percent slopes. This deep, well drained soil is on stream terraces in the north-central part of the survey area. It formed in calcareous alluvium. Areas are elongated or irregular in shape and are 500 to 1,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,700 to 3,750 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 195 to 205 days.

Typically, the surface layer is dark brown very gravelly loam about 4 inches thick. The upper 10 inches of the substratum is light reddish brown extremely gravelly sandy loam, the next 5 inches is light reddish brown extremely gravelly sand, and the lower part to a depth of 60 inches or more is yellowish red very gravelly sand.

Included in this unit are small areas of gravelly, sandy soils on knobs and the steeper side slopes and lma soils

on side slopes and in depressional areas. Included areas make up about 15 percent of the total acreage.

Permeability of this Gallen soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly black grama, blue grama, sideoats grama, and New Mexico feathergrass. The present vegetation in most areas is mainly black grama, sand dropseed, hairy grama, and catclaw mimosa. Plants in the potential plant community that increase because of overgrazing are blue grama, catclaw mimosa, feather dalea, and broom snakeweed. Deferment from grazing during the growing season is needed to maintain or improve the vigor and reproduction of desirable forage plants such as black grama and sideoats grama.

Rangeland seeding is not suitable because of the low precipitation. This unit has limited suitability for livestock watering ponds and other water impoundments because of the seepage potential. Rangeland improvement practices such as livestock water pipelines and fences are difficult to install because of the content of rock fragments.

The average annual production of air-dry vegetation on this unit ranges from 1,450 pounds per acre in favorable years to 450 pounds in unfavorable years.

GbA—Glendale silt loam. This deep, well drained soil is on broad flood plains in the south-central part of the survey area. It formed in calcareous alluvium. Slope is 0 to 1 percent. Areas are elongated or irregular in shape and are 95 to 1,850 acres in size. The vegetation in areas not cultivated is mainly grasses and shrubs. Elevation is 3,575 to 3,700 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

Typically, the surface layer is dark yellowish brown silt loam about 7 inches thick. The upper 33 inches of the substratum is yellowish brown and brown silty clay loam, and the lower part to a depth of 60 inches or more is light brown silt loam.

Included in this unit are small areas of Harkey and Alama soils and soils that have a dark-colored surface layer and are in slightly depressional areas. Also included are small areas of Glendale silty clay loam in slightly depressional areas. Included areas make up about 15 percent of the total acreage.

Permeability of this Glendale soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high. This soil is rarely flooded, but some

areas may be inundated for short periods of time during flash floods. Damage to cropland generally is minimal.

This unit is used for irrigated crops, hay and pasture, urban development, and wildlife habitat. The main crops are alfalfa, cotton, and grain sorghum. Among the other crops grown is small grain. Some areas are used for permanent pasture.

This unit is well suited to all crops commonly grown in the survey area. It is limited mainly by poor tilth.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to the soil in this unit. The method used generally is governed by the crop grown. If irrigation is planned, the quality of water should be tested. Using water of poor quality may necessitate an adjustment in the types of crops planted.

Irrigation water should be applied at a rate that insures optimum production without increasing deep percolation, runoff, and erosion. It should be applied in amounts sufficient to wet the root zone but in amounts small enough to minimize the leaching of plant nutrients. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Leveling helps to insure the uniform application of water. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

The organic matter content of the soil can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes an adequate amount of soil improving crops such as alfalfa or high residue crops. A cropping system that returns a high residue crop to the soil once every 4 years helps to maintain soil tilth. If legumes or grasses are grown in the cropping system, species that can be maintained on the land for at least 3 years should be selected. Fertilizer commonly is used. The application of fertilizer should be based on the needs of the crops grown. Using management that maintains optimum vigor and quality of forage plants is a good practice.

Maintaining crop residue on or near the surface reduces runoff and soil blowing and helps to maintain soil tilth and organic matter content. Soil blowing can also be reduced by keeping the soil rough and cloddy when it is not protected by vegetation, seeding disturbed areas to native or tame pasture, and practicing minimum tillage.

If this unit is used for urban development, the main limitations are the hazard of flooding, moderately slow permeability, moderate shrink-swell potential, low soil strength, and the risk of soil blowing during construction. The hazard of flooding should be evaluated before selecting building sites. If buildings are constructed on the soil in this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and

swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. Preserving as much of the existing plant cover as possible during construction and promptly revegetating disturbed areas around construction sites help to control water erosion and soil blowing.

GHA—Glendale-Harkey association. This map unit is on flood plains in the south-central part of the survey area. Slope is 0 to 1 percent. Areas are irregular or elongated in shape and are 2,000 to 4,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,575 to 3,700 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

This unit is 55 percent Glendale silt loam, 0 to 1 percent slopes, and 25 percent Harkey very fine sandy loam, 0 to 1 percent slopes.

Included in this unit are small areas of Alama soils on alluvial side slopes and low terraces; reddish soils that are less than 18 percent clay and are on alluvial side slopes; and deep, dark-colored soils that are intermingled with the Glendale soil. Included areas make up about 20 percent of the total acreage.

The Glendale soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is yellowish brown silt loam about 6 inches thick. The upper 9 inches of the substratum is yellowish brown silt loam, the next 17 inches is brown silty clay loam, and the lower part to a depth of 60 inches or more is brown and light brown silt loam.

Permeability of the Glendale soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high. This soil is rarely flooded, but some areas may be inundated for short periods of time. Damage to the soil generally is minimal.

The Harkey soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is brown very fine sandy loam about 7 inches thick. The upper 21 inches of the substratum is yellowish brown very fine sandy loam, and the lower part to a depth of 60 inches or more is yellowish brown loam.

Permeability of the Harkey soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high. This soil is rarely flooded, but some areas may be inundated for short periods of time. Damage to the soil generally is minimal.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly giant sacaton, alkali sacaton, tobosa, and vine-mesquite. The present vegetation in most areas is mainly alkali

sacaton, tobosa, burrograss, and mesquite. A plant in the potential plant community that increases because of overgrazing is tobosa. Walkingstick cholla and mesquite readily invade the unit as the plant community deteriorates. If the plant cover is disturbed, protection from flooding is needed to control gullyng, streambank cutting, and sheet erosion.

The average annual production of air-dry vegetation on this unit ranges from 4,800 pounds per acre in favorable years to 2,500 pounds in unfavorable years.

GPA—Glendale-Pecos-Harkey association. This map unit is on the flood plain of the Pecos River. Slope is 0 to 1 percent. Areas are elongated or oblong in shape and are 75 to 1,620 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,500 to 3,700 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

This unit is 40 percent Glendale silt loam, 30 percent Pecos clay loam, and 20 percent Harkey silt loam. The Glendale and Harkey soils are on low ridges, and the Pecos soil is in slightly depressional areas.

Included in this unit are small areas of Bigetty soils and deep, sandy soils on low ridges. Included areas make up about 10 percent of the total acreage.

The Glendale soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is reddish brown silt loam about 8 inches thick. The upper 28 inches of the substratum is reddish brown and brown silt loam, the next 14 inches is reddish brown very fine sandy loam and silt loam, and the lower part to a depth of 60 inches or more is light reddish brown fine sand.

Permeability of the Glendale soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high. This soil is rarely flooded, but some areas may be inundated for short periods of time during flash floods. Damage to the soil generally is minimal.

The Pecos soil is deep and well drained. It formed in stratified, calcareous, saline alluvium. Typically, the surface layer is reddish brown clay loam and silty clay loam about 27 inches thick. The upper 18 inches of the substratum is reddish brown silty clay loam, and the lower part to a depth of 60 inches or more is reddish brown silt loam.

Permeability of the Pecos soil is very slow. Salinity is slight. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is high. This soil is rarely flooded, but some areas may be inundated for short periods of time during flash floods. Damage to the soil generally is minimal.

The Harkey soil is deep and well drained. It formed in loamy, calcareous alluvium. Typically, the surface layer is

brown silt loam about 8 inches thick. The substratum to a depth of 60 inches or more is brown silt loam.

Permeability of the Harkey soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high. The Harkey soil is rarely flooded, but some areas may be inundated for short periods of time during flash floods. Damage to the soil generally is minimal.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly giant sacaton, tobosa, alkali sacaton, and fourwing saltbush. Black walnut trees are scattered throughout the plant community. The unit supports important forage plants such as vine-mesquite. Plants in the potential plant community that increase because of overgrazing are tobosa, alkali sacaton, and poverty threawn. Saltcedar readily invades the unit as the plant community deteriorates.

If the plant cover is disturbed, protection from flooding is needed to control gullyng, streambank cutting, and sheet erosion. Grazing management should be designed to increase the vigor, productivity, and reproduction of giant sacaton and alkali sacaton. Range seeding is a suitable practice. This unit has limited suitability for livestock watering ponds and other water impoundments because of the seepage potential.

The average annual production of air-dry vegetation ranges from 4,800 pounds per acre in favorable years to 2,500 pounds in unfavorable years.

HaA—Harkey very fine sandy loam. This deep, well drained soil is on narrow flood plains in the south-central part of the survey area. It formed in calcareous alluvium. Slope is 0 to 1 percent. Areas are elongated in shape and are 30 to 165 acres in size. The vegetation in areas not cultivated is mainly grasses and shrubs. Elevation is 3,575 to 3,630 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

Typically, the surface layer is yellowish brown very fine sandy loam about 6 inches thick. The upper 17 inches of the substratum is light yellowish brown very fine sandy loam, and the lower part to a depth of 60 inches or more is brown loam.

Included in this unit are small areas of Glendale soils on flood plains and Alama soils on alluvial side slopes at the outer edges of mapped areas. Included areas make up about 15 percent of the total acreage.

Permeability of the Harkey soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high. The Harkey soil is rarely flooded, but some areas

may be inundated for short periods of time during flash floods. Damage to cropland generally is minimal.

This unit is used for irrigated crops, hay and pasture, urban development, and wildlife habitat. The main crops are alfalfa, cotton, and grain sorghum. Among the other crops grown is small grain. Some areas are used for permanent pasture.

This unit is well suited to all crops commonly grown in the survey area.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to the unit. The method used generally is governed by the crop grown. If irrigation is planned, the quality of water should be tested. Using water of poor quality may necessitate an adjustment in the types of crops planted.

Irrigation water needs to be applied at a rate that insures optimum production without increasing deep percolation, runoff, and erosion. Water should be applied in amounts sufficient to wet the root zone but in amounts small enough to minimize the leaching of plant nutrients. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Leveling helps to insure the uniform application of water. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

The organic matter content of the soil can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes an adequate amount of soil improving crops such as alfalfa or high residue crops. A cropping system that returns a high residue crop to the soil once every 4 years helps to maintain soil tilth. If legumes or grasses are grown in the cropping system, species should be selected that can be maintained on the land for at least 3 years. Fertilizer commonly is used. The application of fertilizer should be based on the needs of the crops grown. Using management that maintains optimum vigor and quality of forage plants is a good practice.

Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Soil blowing can also be reduced by keeping the soil rough and cloddy when it is not protected by vegetation, seeding disturbed areas to native or tame pasture plants, and practicing minimum tillage.

If this unit is used for urban development, the main limitations are the hazard of flooding and the risk of soil blowing during construction. The hazard of flooding should be evaluated before selecting building sites. Preserving as much of the existing plant cover as possible during construction and promptly revegetating disturbed areas around construction sites help to control water erosion and soil blowing.

HDA—Hodgins-Ranstein association, gently undulating. This map unit is on broad upland plains and in valleys in the southwestern part of the survey area. Slope is 0 to 3 percent. Areas are elongated or irregular in shape and are 300 to 1,500 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,000 to 4,300 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 58 to 60 degrees F, and the average frost-free period is about 190 to 200 days.

This unit is 45 percent Hodgins silt loam, 0 to 3 percent slopes, and 35 percent Ranstein silt loam, 0 to 1 percent slopes. The Hodgins soil is on long alluvial side slopes, and the Ranstein soil is on valley bottoms and in depressional areas.

Included in this unit are small areas of deep, dark-colored recent alluvial soils along major drainageways and Salt Creek, Reagan soils on alluvial side slopes, and Conger soils on low ridges. Included areas make up about 20 percent of the total acreage.

The Hodgins soil is deep and well drained. It formed in alluvium derived dominantly from limestone. Typically, the surface layer is pale brown silt loam about 3 inches thick. The subsoil is 39 inches thick. The upper 8 inches of the subsoil is yellowish brown silt loam, and the lower 31 inches is pale brown and yellowish brown silty clay loam. The substratum to a depth of 60 inches or more is yellowish brown silty clay loam.

Permeability of the Hodgins soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Ranstein soil is deep and well drained. It formed in calcareous alluvium derived dominantly from limestone. Typically, the surface layer is brown silt loam about 3 inches thick. The subsoil is brown silty clay loam about 46 inches thick. The substratum to a depth of 60 inches or more is yellowish brown silt loam.

Permeability of the Ranstein soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly blue grama, tobosa, black grama, and western wheatgrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Plants in the potential plant community that increase because of overgrazing are ring muhly and sand dropseed. Mesquite readily invades the

Hodgins soil. Rangeland seeding is suitable on both soils in the unit.

Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as blue grama and western wheatgrass. The Ranstein soil receives runoff from adjoining areas, which results in increased production and greater palatability of the forage; therefore, this soil is often overgrazed.

The average annual production of air-dry vegetation on this unit ranges from 1,600 pounds per acre in favorable years to 700 pounds in unfavorable years.

HGC—Hogadero-Pena association, moderately rolling. This map unit is on gravelly alluvial ridges in the northwestern part of the survey area. Slope is 1 to 15 percent. Areas are elongated in shape and are 1,000 to 2,500 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,300 to 4,700 feet. The average annual precipitation is 14 to 15 inches, the average annual air temperature is 54 to 56 degrees F, and the average frost-free period is 180 to 190 days.

This unit is 45 percent Hogadero gravelly loam, 1 to 5 percent slopes, and 35 percent Pena gravelly loam, 5 to 15 percent slopes. The Hogadero soil is on ridgetops and upper side slopes, and the Pena soil is on middle side slopes.

Included in this unit are small areas of Asparas soils on valley bottoms, Threadgill soils on alluvial foot slopes, Pastura soils on ridgetops, and Deama soils on back slopes. Also included are small areas of soils that have slopes of more than 15 percent and are intermingled with the Pena soil. Included areas make up about 20 percent of the total acreage.

The Hogadero soil is deep and well drained. It formed in alluvial deposits derived dominantly from igneous and sedimentary rock. Typically, the surface layer is brown gravelly loam about 10 inches thick. The upper 17 inches of the substratum is white very gravelly sandy loam, the next 28 inches is light brown extremely gravelly loamy sand, and the lower part to a depth of 72 inches is pink extremely gravelly sand.

Permeability of the Hogadero soil is slow in the upper part of the substratum and is rapid below. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is moderate.

The Pena soil is deep and well drained. It formed in alluvium derived dominantly from mixed igneous and sedimentary rock. Typically, the surface layer is dark grayish brown gravelly loam about 9 inches thick. The next layer is pale brown extremely gravelly clay loam about 9 inches thick. The substratum to a depth of 60 inches or more is light yellowish brown and very pale brown extremely gravelly clay loam.

Permeability of the Pena soil is moderate. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly black grama, sideoats grama, little bluestem, and juniper. The present vegetation in most areas is mainly black grama, poverty threeawn, Metcalfe muhly, and hairy tridens. This unit supports important forage plants such as mountainmahogany and skunkbush sumac. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Plants in the potential plant community that increase because of overgrazing are pinyon and juniper. This unit has limited suitability for livestock watering ponds and other water impoundments because of the seepage potential.

The average annual production of air-dry vegetation on this unit ranges from 1,400 pounds per acre in favorable years to 400 pounds in unfavorable years.

HhA—Hollomex loam, 0 to 1 percent slopes. This deep, well drained soil is on low terraces in the south-central part of the survey area. It formed in calcareous, gypsiferous alluvium and residuum. Areas are irregular in shape and are 500 to 3,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,500 to 3,600 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

Typically, the surface layer is grayish brown loam about 3 inches thick. The upper 5 inches of the substratum is light gray gypsiferous loam, and the lower part to a depth of 60 inches or more is white and very pale brown gypsiferous loam.

Included in this unit are small areas of Milner, dry, soils in depressional areas and on ridges, Reeves soils in depressional areas, and a deep, dark-colored soil in depressional areas. Included areas make up about 10 percent of the total acreage.

Permeability of the Hollomex soil is moderate. Available water capacity is very low. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

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

The potential plant community on this unit is mainly gyp grama, gyp muhly, black grama, and alkali sacaton. As the plant community deteriorates, the more palatable

and desirable forage plants such as alkali sacaton and black grama decrease and there is an increase in plants such as gyp muhly and coldenia, which normally occur only in small amounts.

Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as alkali sacaton. Rangeland seeding is not suitable because of the shallow depth to gypsiferous material and the low precipitation. Earthen ponds are not suitable because of the shallow depth to gypsiferous material. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage.

The average annual production of air-dry vegetation on this unit ranges from 900 pounds per acre in favorable years to 350 pounds in unfavorable years.

If this unit is used for urban development, the main limitations are the shallow depth to gypsiferous material and the high hazard of soil blowing. Piping and dissolving of the gypsum are potential limitations. Excavation for houses and access roads in places exposes material that is highly susceptible to soil blowing. Preserving as much of the existing plant cover as possible during construction and promptly revegetating disturbed areas around construction sites help to control water erosion and soil blowing.

HKD—Hollomex-Gypsum land-Alama, dry complex, moderately steep. This map unit is on terrace fronts and dissected terraces in the south-central part of the survey area. Slope is 0 to 25 percent. Areas are elongated or irregular in shape and are 50 to 2,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,600 to 4,100 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

This unit is 30 percent Hollomex loam, 1 to 9 percent slopes; 30 percent Gypsum land, 5 to 25 percent slopes; and 20 percent Alama loam, dry, 0 to 5 percent slopes. The Hollomex soil is on ridges and in depressional areas, the Gypsum land is on eroded knolls and steep escarpments, and the Alama soil is in nearly level depressional areas and on gently sloping side slopes.

Included in this unit are small areas of soils that are similar to the Alama soil but have less clay in the subsoil and substratum and are on side slopes; Milner, dry, and Reeves soils on ridges and side slopes and in depressional areas; Poquita, dry, soils on side slopes; and soils that are high in content of clay and are in depressional areas. Included areas make up about 20 percent of the total acreage.

The Hollomex soil is deep and well drained. It formed in calcareous alluvium and residuum. Typically, the surface layer is yellowish red loam about 2 inches thick. The substratum to a depth of 60 inches or more is pink gypsiferous loam.

Permeability of the Hollomex soil is moderate. Available water capacity is very low. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

Gypsum land consists of stratified beds of gypsum. Hard gypsum is at a depth of about 12 inches.

The Alama soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is yellowish red loam about 5 inches thick. The subsoil is 28 inches thick. The upper 15 inches of the subsoil is yellowish red clay loam, and the lower 13 inches is yellowish red silty clay loam. The substratum to a depth of 60 inches or more is yellowish red silty clay loam.

Permeability of the Alama soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Hollomex and Alama, dry, soils is mainly black grama, blue grama, alkali sacaton, and fourwing saltbush. The present vegetation in most areas is mainly gyp grama, poverty threawn, hairy grama, and sand dropseed. Mesquite readily invades the soils as the plant community deteriorates. Livestock grazing should be managed to protect the soils from excessive erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the soils to produce forage. Rangeland seeding is not suitable because of the shallow depth to gypsiferous material in the Hollomex soil and the low precipitation. Earthen ponds are not suitable on the Hollomex soil because of the shallow depth to gypsiferous material. The total plant growth is barely adequate during normal years to protect the soil surface from erosion; therefore, a suitable grazing management program is to graze the soils only for short periods in fall following seasons of above normal production.

The average annual production of air-dry vegetation on the Hollomex and Alama, dry soils ranges from 1,000 pounds per acre in favorable years to 300 pounds in unfavorable years.

HMA—Hollomex-Reeves-Milner, dry loams, gently undulating. This map unit is on high terraces in the south-central part of the survey area. Slope is 0 to 3 percent. Areas are rectangular or irregular in shape and are 500 to 2,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,600 to 3,900 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

This unit is 40 percent Hollomex loam, 0 to 3 percent slopes, dry; 25 percent Reeves loam, 0 to 2 percent

slopes, dry; and 20 percent Milner loam, 0 to 2 percent slopes, dry. The Hollomex soil is on low knolls and ridges, the Reeves soil is in depressional areas, and the Milner soil is intermingled with the Reeves soil in depressional areas.

Included in this unit are small areas of Gypsum land intermingled with the Hollomex soil on ridges and knolls; deep, dark-colored soils in depressional areas; and soils that are shallow to shale, sandstone, or limestone and are on knolls and ridges. Included areas make up about 15 percent of the total acreage.

The Hollomex soil is deep and well drained. It formed in calcareous, gypsiferous alluvium and residuum. Typically, the surface layer is light brown loam about 5 inches thick. The substratum to a depth of 60 inches or more is very pale brown and pale yellow, gypsiferous loam.

Permeability of the Hollomex soil is moderate. Available water capacity is very low. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Reeves soil is deep and well drained. It formed in alluvium derived dominantly from calcareous material high in content of gypsum. Typically, the surface layer is light brown and brown loam about 8 inches thick. The subsoil is 16 inches thick. The upper 6 inches of the subsoil is yellowish red loam, and the lower 10 inches is reddish yellow clay loam. The substratum to a depth of 60 inches or more is reddish yellow and yellowish red, gypsiferous loam.

Permeability of the Reeves soil is moderate. Salinity is none to slight. Available water capacity is moderate. Effective rooting depth is about 31 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Milner soil is deep and well drained. It formed in calcareous, gypsiferous alluvium. Typically, the surface layer is brown and pale brown loam about 7 inches thick. The subsoil is brown loam about 8 inches thick. The substratum to a depth of 60 inches or more is very pale brown and reddish yellow, gypsiferous loam.

Permeability of the Milner soil is moderate. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Hollomex soil is mainly black grama, gyp grama, gyp muhly, and coldenia. The potential plant community on the Milner and Reeves soils is mainly blue grama, tobosa, black grama, and sand dropseed. Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as blue grama and black grama. Areas that are heavily infested

with undesirable plants can be improved by chemical or mechanical treatment. Earthen ponds are not suited to the unit because of the shallow depth to gypsiferous material. Livestock grazing should be managed to protect the unit from excessive erosion.

The average annual production of air-dry vegetation on this unit ranges from 900 pounds per acre in favorable years to 350 pounds in unfavorable years.

HRB—Hollomex, moist-Milner-Reeves, moist loams, moderately undulating. This map unit is on high terraces in the northern part of the survey area, west of the Pecos River. Slope is 0 to 8 percent. Areas are rectangular or irregular in shape and are 1,000 to 5,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,900 to 4,500 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 195 to 205 days.

This unit is 40 percent Hollomex loam, 0 to 8 percent slopes, moist; 25 percent Milner loam, 0 to 8 percent slopes, moist, and 20 percent Reeves loam, 0 to 2 percent slopes, moist. The Hollomex soil is on knolls and ridges, the Milner soil is in depressional areas and on alluvial side slopes, and the Reeves soil is in depressional areas.

Included in this unit are small areas of exposed unvegetated gypsum layers on knolls and ridges; deep, dark-colored soils in depressional areas; Alama and Poquita soils in depressional areas; and soils that are shallow to shale or sandstone and are on ridges and knolls. Included areas make up about 15 percent of the total acreage.

The Hollomex soil is deep and well drained. It formed in calcareous, gypsiferous alluvium and residuum. Typically, the surface layer is reddish brown loam about 4 inches thick. The upper 16 inches of the substratum is light reddish brown, gypsiferous loam, and the lower part to a depth of 60 inches or more is red, gypsiferous sandy clay loam.

Permeability of the Hollomex soil is moderate. Available water capacity is very low. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Milner soil is deep and well drained. It formed in calcareous, gypsiferous alluvium. Typically, the surface layer is reddish brown loam about 3 inches thick. The subsoil is reddish brown clay loam about 10 inches thick. The substratum to a depth of 60 inches or more is pink, gypsiferous clay loam.

Permeability of the Milner soil is moderate. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is high.

The Reeves soil is deep and well drained. It formed in alluvium derived dominantly from calcareous material high in content of gypsum. Typically, the surface layer is reddish brown loam about 6 inches thick. The subsoil is light reddish brown and yellowish red clay loam about 18 inches thick. The substratum to a depth of 60 inches or more is pink, gypsiferous clay loam.

Permeability of the Reeves soil is moderate. Salinity is none to slight. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Hollomex soils is mainly black grama, gyp grama, gyp muhly, and coldenia. The potential plant community on the Milner and Reeves soil is mainly blue grama, tobosa, black grama, and sand dropseed. Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as black grama and blue grama. Areas that are heavily infested with undesirable plants can be improved by chemical treatment. Earthen ponds are not suited to the unit because of the shallow depth to gypsiferous material. If the plant cover is disturbed, protection is needed to control gullying, streambank cutting, and sheet erosion.

The average annual production of air-dry vegetation on this unit ranges from 900 pounds per acre in favorable years to 350 pounds in unfavorable years.

1aA—1ma loamy fine sand, 0 to 3 percent slopes.

This deep, well drained soil is on alluvial side slopes below landscape breaks in the eastern and southwestern parts of the survey area. It formed in alluvium. Areas are oblong or irregular in shape and are 80 to 1,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,750 to 4,500 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 58 to 60 degrees F, and the average frost-free period is 195 to 200 days.

Typically, the surface layer is reddish brown loamy fine sand about 8 inches thick. The subsoil is reddish brown fine sandy loam about 25 inches thick. The substratum to a depth of 60 inches or more is reddish brown fine sandy loam.

Included in this unit are small areas of Latom and Blakeney soils on ridges and Roswell soils on coppice dunes. Included areas make up about 15 percent of the total acreage.

Permeability of the 1ma soil is moderately rapid. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is very high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly sand bluestem, plains bristlegrass, little bluestem, and black grama. The present vegetation in most areas is mainly sand dropseed, poverty threeawn, spike dropseed, and shinnery oak. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Plants in the potential plant community that increase because of overgrazing are shinnery oak, poverty threeawn, sand dropseed, and sand sagebrush. Shinnery oak readily invades. In areas where shinnery oak is dominant, livestock should be removed when the shinnery oak is in late bud or early leaf stage because of its toxicity during this period.

Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as sand bluestem, little bluestem, and black grama. Mechanical brush control and mechanical treatment are not suitable because of the risk of soil blowing. Rangeland seeding is not suitable because of the low precipitation.

This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential. Livestock grazing should be managed to protect the unit from excessive erosion. Loss of surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage.

The average annual production of air-dry vegetation on this unit ranges from 3,000 pounds per acre in favorable years to 1,500 pounds in unfavorable years.

1BB—1ma-Blakeney complex, moderately

undulating. This map unit is on uplands in the southwestern part of the survey area. Slope is 0 to 5 percent. Areas are irregular in shape and are 2,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,200 to 4,400 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 58 to 60 degrees F, and the average frost-free period is 190 to 200 days.

This unit is 45 percent 1ma fine sand, 0 to 3 percent slopes, and 40 percent Blakeney cobbly sandy loam, 0 to 5 percent slopes. The 1ma soil is on ridges and in depressional areas, and the Blakeney soil is on ridges.

Included in this unit are small areas of Roswell soils in areas of dunes, Reagan soils in depressional areas, and Kimbrough soils on low ridges and side slopes. Included areas make up about 15 percent of the total acreage.

The 1ma soil is deep and well drained. It formed in alluvium. Typically, the surface layer is yellowish brown and dark yellowish brown fine sand about 14 inches thick. The subsoil is 32 inches thick. The upper 5 inches of the subsoil is brown loamy very fine sand, and the lower 27 inches is strong brown fine sandy loam. The

substratum to a depth of 60 inches or more is strong brown fine sandy loam.

Permeability of the Ima soil is moderately rapid. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is very high.

The Blakeney soil is shallow and well drained. It formed in calcareous alluvium. Typically, the surface layer is brown cobbly sandy loam about 4 inches thick. The subsoil is yellowish brown cobbly sandy loam about 8 inches thick. Indurated caliche is at a depth of 12 inches.

Permeability of the Blakeney soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 8 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly black grama, plains bristlegrass, bush muhly, and small soapweed. The present vegetation in most areas is mainly yucca, sacahuista, poverty threeawn, and broom snakeweed. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. As the plant community deteriorates, mesquite readily invades the Blakeney soil and sacahuista readily invades both soils.

Deferment from grazing during the growing season is needed to maintain or improve the vigor and reproduction of desirable forage plants such as black grama. Rangeland improvement practices such as livestock water pipelines are difficult to install on the Blakeney soil because of the shallow depth to caliche. Rangeland seeding is not suitable because of the low precipitation. Loss of the surface layer results in a severe decrease in productivity and in the potential of the Blakeney soil to produce forage. This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential and the shallow depth to caliche in the Blakeney soil.

The average annual production of air-dry vegetation on this unit ranges from 800 pounds per acre in favorable years to 300 pounds in unfavorable years.

JaA—Jalmar fine sand, moist. This deep, well drained soil is on high plains in the eastern part of the survey area. It formed in alluvial and eolian deposits. Slope is 0 to 2 percent. Areas are irregular in shape and are 380 to 3,200 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,400 to 4,500 feet. The average annual precipitation is 14 to 15 inches,

the average annual air temperature is 58 to 60 degrees F, and the average frost-free period is 185 to 195 days.

Typically, the surface layer is brown fine sand and loamy fine sand about 23 inches thick. The subsoil is reddish yellow and reddish brown sandy clay loam about 37 inches thick or more.

Included in this unit are small areas of Faskin, Douro, and Portales soils. Included areas make up about 10 percent of the total acreage.

Permeability of the Jalmar soil is moderate. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly sand bluestem, little bluestem, red lovegrass, and shinnery oak. The present vegetation in most areas is mainly giant dropseed, poverty threeawn, small soapweed, and sand sagebrush. As the plant community deteriorates, the more palatable and desirable forage plants such as sand bluestem and little bluestem decrease and there is an increase in plants such as shinnery oak, small soapweed, and sand sagebrush, which normally occur only in small amounts. Further deterioration results in the total domination of the plant community by shinnery oak, with very little production of grass. In areas where shinnery oak is dominant, livestock should be removed when the shinnery oak is in late bud or early leaf stage because of its toxicity during this period.

Rangeland seeding is suitable, but it is limited because of low precipitation. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage.

The average annual production of air-dry vegetation on this unit ranges from 3,200 pounds per acre in favorable years to 1,800 pounds in unfavorable years.

JRC—Jalmar-Roswell-Pyote association, moderately undulating. This map unit is on high terraces in the eastern part of the survey area. Slope is 0 to 15 percent. Areas are irregular in shape and are 500 to 3,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,900 to 4,100 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 195 to 205 days.

This unit is 50 percent Jalmar fine sand, 0 to 2 percent slopes; 20 percent Roswell fine sand, 2 to 15 percent slopes; and 20 percent Pyote fine sand, 2 to 5 percent slopes. The Jalmar soil is on plains, the Roswell soil is on dunes, and the Pyote soil is on hummocks.

Included in this unit are small areas of Faskin, Malstrom, and Stromal soils on plains. Included areas make up about 10 percent of the total acreage.

The Jalmar soil is deep and well drained. It formed in alluvial and eolian deposits. Typically, the surface layer is brown and light brown fine sand about 26 inches thick. The subsoil is yellowish red and reddish yellow sandy clay loam about 34 inches thick or more.

Permeability of the Jalmar soil is moderate. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

The Roswell soil is deep and excessively drained. It formed in eolian deposits. Typically, the surface layer is light brown fine sand about 13 inches thick. The substratum to a depth of 60 inches or more is pink fine sand.

Permeability of the Roswell soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

The Pyote soil is deep and well drained. It formed in alluvial and eolian deposits. Typically, the surface layer is strong brown and brown fine sand and reddish yellow loamy fine sand about 24 inches thick. The subsoil is yellowish red fine sandy loam about 11 inches thick. The substratum to a depth of 60 inches or more is reddish yellow loamy fine sand.

Permeability of the Pyote soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly sand bluestem, little bluestem, plains bristlegrass, and shinnery oak. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Plants in the potential plant community that increase because of overgrazing are shinnery oak and sand sagebrush. Further deterioration results in total domination of the plant community by shinnery oak, with very little production of grass. In areas where shinnery oak is dominant, livestock should be removed when the shinnery oak is in late bud or early leaf stage because of its toxicity during this period. Mesquite readily invades the Jalmar soil.

Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as sand bluestem and little bluestem. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage. This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The average annual production of air-dry vegetation on this unit ranges from 3,000 pounds per acre in favorable years to 1,300 pounds in unfavorable years.

KAA—Kimbrough-Slaughter complex, gently undulating. This map unit is on high plains in the eastern part of the survey area. Slope is 0 to 2 percent. Areas are irregular in shape and are 300 to 3,800 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,300 to 4,500 feet. The average annual precipitation is 14 to 15 inches, the average annual air temperature is 58 to 60 degrees F, and the average frost-free period is 185 to 195 days.

This unit is 70 percent Kimbrough gravelly fine sandy loam, 0 to 2 percent slopes, and 20 percent Slaughter clay loam, 0 to 1 percent slopes. The Kimbrough soil is on low ridges, and the Slaughter soil is in depressional areas.

Included in this unit are small areas of Kimbrough soils that have slopes of 3 to 7 percent and are on breaks around playa lakes, a few playa lakes, and small areas of soils that are moderately deep to indurated caliche. Included areas make up about 10 percent of the total acreage.

The Kimbrough soil is shallow and well drained. It formed in calcareous alluvium. Typically, the surface layer is brown gravelly fine sandy loam about 11 inches thick. Indurated caliche is at a depth of 11 inches.

Permeability of the Kimbrough soil is moderate. Available water capacity is very low. Effective rooting depth is 4 to 17 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is high.

The Slaughter soil is shallow and well drained. It formed in calcareous alluvium. Typically, the surface layer is brown clay loam about 5 inches thick. The subsoil is reddish brown clay about 9 inches thick. Indurated caliche is at a depth of 14 inches.

Permeability of the Slaughter soil is moderately slow. Available water capacity is very low. Effective rooting depth is 9 to 20 inches. Runoff is medium and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Kimbrough soil is mainly sideoats grama, black grama, blue grama, and New Mexico feathergrass. The potential plant community on the Slaughter soil is mainly blue grama, sideoats grama, tobosa, and vine-mesquite. The Slaughter soil receives runoff from adjoining areas resulting in a greater production and palatability of the forage; therefore, this soil is often overgrazed. As the plant community deteriorates, the more palatable and desirable forage plants such as sideoats grama and vine-mesquite decrease and there is an increase in plants such as blue grama, ring muhly, hairy tridens, and broom snakeweed,

which normally occur only in small amounts. Walkingstick cholla and mesquite readily invade the unit.

Rangeland seeding is not suitable because of the shallow depth to caliche and low precipitation. Mechanical brush control has limited suitability on the Slaughter soil and is not suitable on the Kimbrough soil. Areas that are heavily infested with undesirable plants can be improved by chemical treatment. Rangeland improvement practices such as livestock water pipelines, fences, and water impoundment facilities are difficult to install on this unit because of the shallow depth to caliche.

The average annual production of air-dry vegetation on this unit ranges from 800 pounds per acre in favorable years to 350 pounds in unfavorable years.

KEC—Kimbrough, dry-Ector association, moderately undulating. This map unit is on uplands in the southwestern part of the survey area. Slope is 0 to 15 percent. Areas are irregular or elongated in shape and are 1,500 to 2,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,200 to 4,500 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 58 to 60 degrees F, and the average frost-free period is 190 to 200 days.

This unit is 50 percent Kimbrough gravelly loam, 0 to 5 percent slopes, dry, and 35 percent Ector very cobbly loam, 3 to 15 percent slopes. The Kimbrough soil is on ridges, and the Ector soil is on back slopes.

Included in this unit are small areas of deep, dark-colored soils in drainageways and depressional areas, Reagan soils in depressional areas on broad ridgetops, and deep, clayey soils in drainageways. Included areas make up about 15 percent of the total acreage.

The Kimbrough soil is shallow and well drained. It formed in calcareous alluvium. Typically, the surface layer is dark grayish brown gravelly loam about 6 inches thick. Indurated caliche is at a depth of 6 inches.

Permeability of the Kimbrough soil is moderate. Available water capacity is very low. Effective rooting depth is 4 to 17 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is moderate.

The Ector soil is shallow and well drained. It formed in residuum derived dominantly from limestone. Typically, the surface layer is very dark grayish brown very cobbly loam about 5 inches thick. The substratum is dark brown very cobbly loam about 7 inches thick. Limestone is at a depth of 12 inches.

Permeability of the Ector soil is moderate. Available water capacity is very low. Effective rooting depth is 7 to 20 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is slight.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly black grama, sideoats grama, New Mexico feathergrass, and Metcalfe muhly. The present vegetation in most areas is mainly blue grama, Metcalfe muhly, hairy grama, and black grama. The unit also supports important forage plants such as winterfat. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as black grama and New Mexico feathergrass. Rangeland seeding is not suitable because of shallow depth to caliche or limestone and the low precipitation. Rangeland improvement practices such as livestock water pipelines, fences, and water impoundment facilities are difficult to install on this unit because of the shallow depth to caliche or limestone. The total plant growth is barely adequate during normal years to protect the soil surface from erosion; therefore, a suitable grazing management program is to graze the unit only for short periods in fall following seasons of above normal production.

The average annual production of air-dry vegetation on this unit ranges from 1,200 pounds per acre in favorable years to 400 pounds in unfavorable years.

LAC—Latom fine sandy loam, moderately rolling. This shallow, well drained soil is on low ridges and erosional side slopes of uplands in the eastern part of the survey area. It formed in residuum derived dominantly from sandstone. Slope is 3 to 15 percent. Areas are long and narrow in shape and are 100 to 300 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,950 to 4,100 feet. The average annual precipitation is 14 to 15 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 195 to 205 days.

Typically, the surface layer is reddish brown and light reddish brown fine sandy loam about 8 inches thick. The substratum is pink fine sandy loam about 9 inches thick. Sandstone is at a depth of 17 inches.

Included in this unit are small areas of soils that have a sandy clay loam subsoil and are 20 to 40 inches deep to sandstone, soils that are more than 20 inches deep, fine textured soils that are 20 to 40 inches deep, soils that have a clay loam subsoil and are less than 20 inches deep to sandstone, and Rock outcrop. Included areas make up about 20 percent of the total acreage.

Permeability of the Latom soil is moderate. Available water capacity is very low. Effective rooting depth is 4 to 20 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly blue grama, sideoats grama, black grama, and little bluestem. The unit supports important forage plants such as skunkbush sumac and winterfat. It can support scattered juniper. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

Deferment from grazing during the growing season is needed to maintain or improve the vigor and reproduction of desirable forage plants such as black grama and little bluestem. Rangeland seeding is not suitable because of the shallow soil depth and low precipitation. Livestock grazing should be managed to protect the soil in this unit from excessive erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the soil to produce forage. The total plant growth is barely adequate during normal years to protect the surface from erosion; therefore, a suitable grazing management program is to graze the unit only for short periods in fall following seasons of above normal production. Rangeland improvement practices such as livestock water pipelines and water impoundment facilities are difficult to install because of the shallow depth to sandstone.

The average annual production of air-dry vegetation on this unit ranges from 1,200 pounds per acre in favorable years to 400 pounds in unfavorable years.

LRD—Latom-Rock outcrop-Philder complex, moderately steep. This map unit is on terraces along the Pecos River, in the north-central part of the survey area. Slope is 3 to 30 percent. Areas are long and narrow in shape and are 100 to 1,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,700 to 4,000 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 195 to 205 days.

This unit is 30 percent Latom fine sandy loam, 3 to 15 percent slopes; 30 percent Rock outcrop, 5 to 30 percent slopes; and 20 percent Philder gravelly fine sandy loam, 3 to 8 percent slopes. The Latom soil and Rock outcrop are on high terraces, terrace fronts, and escarpments, and the Philder soil is on high terraces.

Included in this unit are small areas of Ratliff and Malstrom soils on side slopes of drainageways and Ima soils on alluvial fans. Included areas make up about 20 percent of the total acreage.

The Latom soil is shallow and well drained. It formed in residuum derived dominantly from sandstone. Typically, the surface layer is reddish brown fine sandy loam about 5 inches thick. The substratum is reddish brown fine sandy loam about 15 inches thick. Pinkish gray sandstone is at a depth of 20 inches.

Permeability of the Latom soil is moderate. Available water capacity is very low. Effective rooting depth is 4 to 20 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is high.

Rock outcrop is exposures of unweathered sandstone. It supports little if any vegetation. Surface runoff is rapid.

The Philder soil is shallow and well drained. It formed in calcareous alluvium. Typically, the surface layer is reddish yellow gravelly fine sandy loam about 4 inches thick. The subsoil is light reddish brown very gravelly fine sandy loam about 3 inches thick. Indurated caliche is at a depth of 7 inches.

Permeability of the Philder soil is moderate. Available water capacity is very low. Effective rooting depth is 4 to 9 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Latom and Philder soils is mainly black grama, blue grama, sideoats grama, and catclaw acacia. The present vegetation in most areas is mainly hairy grama, wolftail, poverty threawn, and catclaw acacia. The Latom soil can support scattered pinyon and juniper trees. If the plant cover is disturbed, practices are needed to control gullying and sheet erosion. Steepness of slope limits access by livestock and encourages overgrazing of the less sloping areas.

Mechanical treatment is not practical because of rock fragments and steepness of slopes. Loss of the surface layer results in a severe decrease in productivity and in the potential of the Latom and Philder soils to produce forage. Rangeland seeding is not suitable because of the shallow soil depth and low precipitation. The total plant growth is barely adequate during normal years to protect the soil surface from erosion; therefore, a suitable grazing management program is to graze the soils only for short periods in fall following seasons of above normal production. Rangeland improvement practices such as fences, livestock water pipelines, and livestock trails are difficult to install on these soils because of shallow soil depth and steepness of slope. The soils are limited for livestock watering ponds and other water impoundments because of the seepage potential and shallow soil depth.

The average annual production of air-dry vegetation on the Latom and Philder soils ranges from 1,200 pounds per acre in favorable years to 400 pounds in unfavorable years.

MaA—Milner loam, 0 to 3 percent slopes. This deep, well drained soil is on terraces in the south-central part of the survey area. It formed in calcareous, gypsiferous alluvium. Areas are irregular in shape and are 5 to 20 acres in size. The vegetation in areas not cultivated is mainly grasses and shrubs. Elevation is 3,550 to 3,600 feet. The average annual precipitation is

11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

Typically, the surface layer is brown loam about 4 inches thick. The subsoil is brown loam 12 inches thick. The substratum to a depth of 60 inches or more is pink, gypsiferous clay loam.

Included in this unit are small areas of Reeves and Hollomex soils on terraces. Included areas make up about 10 percent of the total acreage.

Permeability of the Milner soil is moderate. Available water capacity is very low. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for irrigated crops, hay and pasture, urban development, and wildlife habitat. The main crops are alfalfa, cotton, grain sorghum, small grain, and permanent pasture.

This unit is suited to all crops commonly grown in the survey area. It is limited mainly by shallow depth to gypsiferous material and very low available water capacity. Limited yields of alfalfa can be expected as well as limited stand longevity because of the shallow depth to gypsiferous material.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to the unit. The method used generally is governed by the crop grown. If irrigation is planned, the quality of water should be tested. Using water of poor quality may necessitate an adjustment in the types of crops planted.

Irrigation water should be applied at a rate that insures optimum production without increasing deep percolation, runoff, and erosion. Water should be applied in amounts sufficient to wet the root zone but in amounts small enough to minimize the leaching of plant nutrients. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Leaching of salts helps to prevent the accumulation of salts in the root zone of crops. The soil in this unit tends to be droughty and to require frequent irrigations.

Leveling helps to insure the uniform application of water. Deep leveling cuts should be avoided because of the extremely shallow depth to gypsiferous material. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

The organic matter content of the soil can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes an adequate amount of soil improving crops such as alfalfa or high residue crops. A cropping system that returns a high residue crop to the soil 2 years in 3 helps to maintain or improve the rate of water intake and reduces runoff and erosion. If legumes or grasses are grown in

the cropping system, species should be selected that can be maintained on the land for at least 3 years. Fertilizer commonly is used. The application of fertilizer should be based on the needs of the crops grown. Using management that maintains optimum vigor and quality of forage plants is a good practice.

Tilth and fertility can be improved by returning crop residue to the soil. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Soil blowing can be controlled by keeping the soil rough and cloddy when it is not protected by vegetation. Seeding disturbed areas to native or tame pasture plants reduces soil blowing. Soil blowing can also be reduced by returning crop residue to the soil and practicing minimum tillage.

If this unit is used for urban development, the main limitations are shallow depth to gypsiferous material and the risk of soil blowing during construction. Dissolving of the gypsum is a potential limitation. If buildings are constructed on the Milner soil, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling. Excavation for houses and access roads in places exposes material that is highly susceptible to soil blowing. Preserving as much of the existing plant cover as possible during construction and promptly revegetating disturbed areas around construction sites help to control water erosion and soil blowing.

NFC—Nutivoli-Faskin, moist fine sands, moderately rolling. This map unit is on high plains in the northeastern part of the survey area. Slope is 0 to 13 percent. Areas are irregular in shape and are 1,500 to 6,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,100 to 4,500 feet. The average annual precipitation is 14 to 15 inches, the average annual air temperature is 58 to 60 degrees F, and the average frost-free period is 185 to 195 days.

This unit is 40 percent Nutivoli fine sand, 2 to 13 percent slopes, and 40 percent Faskin fine sand, 0 to 2 percent slopes, moist. The Nutivoli soil is on dunes, and the Faskin soil is in depressional and interdunal areas.

Included in this unit are small areas of Faskin loamy fine sand, Nutivoli loamy fine sand, Jalmar soils, and Ratliff soils. Included areas make up about 20 percent of the total acreage.

The Nutivoli soil is deep and excessively drained. It formed in eolian deposits. Typically, the surface layer is brown fine sand about 6 inches thick. The upper 34 inches of the substratum is red and yellowish red loamy fine sand, and the lower part to a depth of 60 inches or more is yellowish red fine sand.

Permeability of the Nutivoli soil is rapid. Available water capacity is low. Effective rooting depth is 60

inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

The Faskin soil is deep and well drained. It formed in alluvial and eolian deposits. Typically, the surface layer is reddish brown fine sand about 10 inches thick. The subsoil is yellowish red, red, and light reddish brown sandy clay loam about 50 inches thick.

Permeability of the Faskin soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is very high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Nutivoli soil is mainly sand bluestem, little bluestem, giant sandreed, and shinnery oak. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Plants in the potential plant community that increase because of overgrazing are shinnery oak and sand sagebrush. Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as sand bluestem and little bluestem.

The average annual production of air-dry vegetation on this soil ranges from 2,400 pounds per acre in favorable years to 1,400 pounds in unfavorable years.

The potential plant community on the Faskin soil is mainly sand bluestem, sideoats grama, little bluestem, and New Mexico feathergrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Deterioration of the plant community results in a total domination by shinnery oak and sand sagebrush, with very little production of grass. In areas where shinnery oak is dominant, livestock should be removed when the shinnery oak is in late bud or early leaf stage because of its toxicity to livestock during this period.

The average annual production of air-dry vegetation on this soil ranges from 1,600 pounds per acre in favorable years to 800 pounds in unfavorable years.

Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage. Mechanical brush control and mechanical treatment are not suitable because of the hazard of soil blowing.

NJC—Nutivoli-Jalmar, moist fine sands, moderately rolling. This map unit is on high plains in the eastern part of the survey area. Slope is 0 to 13 percent. Areas are irregular in shape and are 250 to 2,500 acres in size.

The native vegetation is mainly grasses and shrubs. Elevation is 4,400 to 4,500 feet. The average annual precipitation is 14 to 15 inches, the average annual air temperature is 58 to 60 degrees F, and the average frost-free period is 185 to 195 days.

This unit is 50 percent Nutivoli fine sand, 2 to 13 percent slopes, and 40 percent Jalmar fine sand, moist, 0 to 1 percent slopes. The Nutivoli soil is on dunes, and the Jalmar soil is in depressional and interdunal areas.

Included in this unit are small areas of Faskin, Douro, and Portales soils in depressional and interdunal areas. Included areas make up about 10 percent of the total acreage.

The Nutivoli soil is deep and excessively drained. It formed in eolian deposits. Typically, the surface layer is light brown fine sand about 9 inches thick. The substratum to a depth of 60 inches or more is light reddish brown and reddish yellow fine sand.

Permeability of the Nutivoli soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

The Jalmar soil is deep and well drained. It formed in alluvial and eolian deposits. Typically, the surface layer is light brown and strong brown fine sand about 28 inches thick. The subsoil is yellowish red and red sandy clay loam about 34 inches thick.

Permeability of the Jalmar soil is moderate. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Nutivoli soil is mainly sand bluestem, little bluestem, giant sandreed, and red lovegrass. The present vegetation in most areas is mainly sand bluestem, sand dropseed, small soapweed, and shinnery oak. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. As the plant community deteriorates, the more palatable and desirable forage plants such as sand bluestem and little bluestem decrease and there is an increase in plants such as shinnery oak, sand sagebrush, and small soapweed, which normally occur only in small amounts.

The average annual production of air-dry vegetation on this soil ranges from 2,400 pounds per acre in favorable years to 1,400 pounds in unfavorable years.

The potential plant community on the Jalmar soil is mainly sand bluestem, little bluestem, black grama, and sand dropseed. Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as sand bluestem and little bluestem.

The average annual production of air-dry vegetation on this soil ranges from 3,200 pounds per acre in favorable years to 1,800 pounds in unfavorable years.

Shinnery oak readily invades the unit. In areas where shinnery oak is dominant, livestock should be removed when the shinnery oak is in late bud or early leaf stage because of its toxicity during this period. Rangeland seeding is suitable on both soils. Mechanical brush control and mechanical treatment are not suitable because of the hazard of soil blowing.

PaA—Pajarito loamy fine sand, 0 to 3 percent slopes. This deep, well drained soil is on alluvial side slopes below landscape breaks in the south-central part of the survey area. It formed in calcareous alluvium. Areas are elongated or irregular in shape and are 200 to 3,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,700 to 3,800 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

Typically, the surface layer is reddish brown loamy fine sand about 4 inches thick. The subsoil is reddish brown sandy loam about 33 inches thick. The substratum to a depth of 60 inches or more is reddish brown sandy loam.

Included in this unit are small areas of eroded Pajarito soils on low coppice dunes scattered throughout the unit, soils that are shallow to bedrock and are on ridges, and Simona soils on ridges. Included areas make up about 10 percent of the total acreage.

Permeability of the Pajarito soil is moderately rapid. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is very high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly little bluestem, black grama, plains bristlegrass, and mesa dropseed. The present vegetation in most areas is mainly sand dropseed, poverty threeawn, tobosa, and bush muhly. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Plants in the potential plant community that increase because of overgrazing are tobosa and sand dropseed. Mesquite readily invades the unit. Further deterioration results in the total domination of the plant community by mesquite, with very little production of grass.

Deferment from grazing during the growing season is needed to maintain or improve the vigor and reproduction of desirable forage plants such as black grama. Rangeland seeding is not suitable because of the low precipitation. Areas that are heavily infested with

undesirable plants can be improved by chemical or mechanical treatment. Livestock grazing should be managed to protect the unit from excessive erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage.

The average annual production of air-dry vegetation on this unit ranges from 1,800 pounds per acre in favorable years to 650 pounds in unfavorable years.

PBB—Pajarito-Bluepoint complex, hummocky. This map unit is on alluvial side slopes below landscape breaks in the south-central part of the survey area. Slope is 0 to 5 percent. Areas are elongated or irregular in shape and are 500 to 4,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,600 to 3,800 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

This unit is 40 percent Pajarito fine sandy loam, 0 to 5 percent slopes, eroded; and 40 percent Bluepoint loamy fine sand, 2 to 5 percent slopes. The Pajarito soil is in interdunal areas, and the Bluepoint soil is on coppice dunes.

Included in this unit are small areas of soils that have slopes of more than 5 percent; Sotim, Berino, Reeves, and Hollomex soils in interdunal areas, and Pajarito loamy fine sand in interdunal areas and on coppice dunes. Included areas make up about 20 percent of the total acreage.

The Pajarito soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is reddish brown fine sandy loam about 5 inches thick. The subsoil is reddish brown fine sandy loam about 27 inches thick. The upper 11 inches of the substratum is yellowish red fine sandy loam, and the lower part to a depth of 60 inches or more is yellowish red loamy fine sand.

Permeability of the Pajarito soil is moderately rapid. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Bluepoint soil is deep and somewhat excessively drained. It formed in calcareous eolian deposits. Typically, the surface layer is reddish brown and yellowish red loamy fine sand about 20 inches thick. The substratum to a depth of 60 inches or more is yellowish red and reddish brown loamy fine sand.

Permeability of the Bluepoint soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly black grama, hooded windmillgrass, blue grama, and mesa dropseed. The present vegetation in most areas is mainly blue grama, sand dropseed, silver bluestem, and tobosa. Small soapweed is scattered throughout the plant community. Deterioration results in a total domination of the plant community by sand sagebrush and mesquite, with very little production of grass.

Rangeland seeding is not suitable because of the low precipitation. Mechanical brush control and mechanical treatment are not suitable because of the hazard of soil blowing. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage. This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The average annual production of air-dry vegetation on this unit ranges from 1,100 pounds per acre in favorable years to 600 pounds in unfavorable years.

PDB—Pastura-Darvey association, moderately undulating. This map unit is on plateaus in the northwestern part of the survey area. Slope is 0 to 5 percent. Areas are irregular in shape and are 500 to 1,500 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,600 to 4,900 feet. The average annual precipitation is 14 to 15 inches, the average annual air temperature is 54 to 56 degrees F, and the average frost-free period is 180 to 190 days.

This unit is 50 percent Pastura loam, 0 to 5 percent slopes, and 40 percent Darvey loam, 0 to 5 percent slopes. The Pastura soil is on ridges and knolls, and the Darvey soil is on alluvial side slopes and in depressional areas.

Included in this unit are small areas of loamy soils that are highly calcareous to a depth of 20 inches and are on alluvial side slopes; deep, dark-colored soils in low-lying areas; Pastura cobbly loam on ridges and knolls; and soils that are more than 20 inches deep to caliche and are on ridges and knolls. Included areas make up about 10 percent of the total acreage.

The Pastura soil is shallow and well drained. It formed in calcareous alluvium. Typically, the surface layer is brown loam about 8 inches thick. The substratum is brown clay loam and brown cobbly loam about 9 inches thick. Indurated caliche is at a depth of 17 inches.

Permeability of the Pastura soil is moderate. Available water capacity is very low. Effective rooting depth is about 5 to 20 inches. Runoff is rapid, and the hazard to water erosion is high. The hazard of soil blowing is high.

The Darvey soil is deep and well drained. It formed in calcareous alluvium derived dominantly from limestone. Typically, the surface layer is brown loam about 4 inches thick. The subsoil is about 33 inches thick. The upper 25 inches of the subsoil is brown loam, and the lower 8 inches is light brown clay loam. The substratum to a

depth of 60 inches or more is pink, light brown, and reddish brown clay loam.

Permeability of the Darvey soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Pastura soil is mainly sideoats grama, black grama, blue grama, and New Mexico feathergrass. The potential plant community on the Darvey soil is mainly blue grama, black grama, sideoats grama, and tobosa. Plants in the potential plant community that increase because of overgrazing are threawn, ring muhly, and broom snakeweed. Rangeland seeding is suitable on the Darvey soil, but it is limited because of the low precipitation. Rangeland improvement practices such as livestock water pipelines, fences, and water impoundment facilities are difficult to install on the Pastura soil because of the shallow depth to caliche.

The average annual production of air-dry vegetation on this unit ranges from 1,100 pounds per acre in favorable years to 300 pounds in unfavorable years.

PeA—Pecos silty clay loam. This deep, moderately well drained soil is on flood plains in the south-central part of the survey area. It formed in stratified, clayey, calcareous alluvium. Slope is 0 to 1 percent. Areas are elongated or irregular in shape and are 10 to 55 acres in size. The vegetation in areas not cultivated is mainly salt tolerant grasses and shrubs. Elevation is 3,550 to 3,700 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

Typically, the surface layer is reddish brown silty clay loam about 12 inches thick. The upper 10 inches of the substratum is reddish brown clay, the next 20 inches is reddish brown silty clay and silty clay loam, and the lower part to a depth of 60 inches or more is brown loam and fine sandy loam.

Included in this unit are small areas of Bigetty, Glendale, and Harkey soils. Also included are small areas of Pecos silty clay loam, 1 to 3 percent slopes. Included areas make up about 15 percent of the total acreage.

Permeability of the Pecos soil is very slow. Salinity is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is high. The Pecos soil is rarely flooded, but some areas may be inundated for short periods of time during flash floods. Damage to cropland generally is minimal.

This unit is used for irrigated crops, hay and pasture, urban development, and wildlife habitat. The main crops

are alfalfa, cotton, and grain sorghum. Among the other crops grown are small grain and permanent pasture.

This unit is suited to all crops commonly grown in the survey area. It is limited mainly by unfavorable soil tilth, the hazard of rare flooding, very slow permeability, and moderate salinity.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to the soil in this unit. If sprinkler irrigation is used, water should be applied slowly to minimize runoff. Water should be applied at a slow rate over a long period to insure that the root zone is properly wetted. Because of the very slow permeability of the soil, the length of runs should be adjusted to permit adequate infiltration of water. If irrigation is planned, the quality of water should be tested. Using water of poor quality may necessitate an adjustment in the types of crops planted. Irrigation water should be applied at a rate that insures optimum production without increasing deep percolation, runoff, and erosion. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Leveling helps to insure the uniform application of water. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

The organic matter content of the soil can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes an adequate amount of soil improving crops such as alfalfa and high residue crops. A cropping system that returns a high residue crop to the soil 2 years in 3 helps to maintain or improve soil tilth and water intake. If legumes or grasses are grown in the cropping system, species should be selected that can be maintained on the land for at least 3 years. Fertilizer commonly is used. The application of fertilizer should be based on the needs of the crops grown.

Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Soil blowing can also be reduced by returning crop residue to the soil, practicing minimum tillage, keeping the soil rough and cloddy when it is not protected by vegetation, and seeding disturbed areas to native or tame pasture plants. Crusting of the surface and compaction of the soil can be reduced by returning crop residue to the soil and by using minimum tillage. Returning crop residue to the soil or regularly adding other organic matter also improves fertility, reduces crusting, and increases the water intake rate.

Intensive management is required to reduce the salinity of the soil and maintain its productivity. Using management that maintains optimum vigor and quality of forage plants is a good practice.

If this unit is used for urban development, the main limitations are the hazard of flooding, very slow permeability, high shrink-swell potential, moderate salinity, low soil strength, and the risk of soil blowing during construction. The hazard of flooding should be evaluated before selecting building sites. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. Preserving as much of the existing plant cover as possible during construction and promptly revegetating disturbed areas around construction sites help to control water erosion and soil blowing.

PoA—Poquita fine sandy loam, dry. This deep, well drained soil is on alluvial side slopes in the south-central part of the survey area. It formed in calcareous alluvium. Slope is 0 to 3 percent. The unit consists of an area that is irregular in shape and is 2,516 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,700 to 3,900 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

Typically, the surface layer is brown fine sandy loam about 12 inches thick. The subsoil is reddish brown and light reddish brown loam about 16 inches thick. The substratum to a depth of 60 inches or more is reddish yellow clay loam.

Included in this unit are small areas of Simona and Bascal soils on low ridges and soils that have sandstone fragments throughout and are on low ridges. Also included are small areas of Alama soils in depressional areas. Included areas make up about 20 percent of the total acreage.

Permeability of the Poquita soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly black grama, blue grama, mesa dropseed, and small soapweed. The present vegetation in most areas is mainly sand dropseed, poverty threeawn, tobosa, and common javalinabush. This unit supports important forage plants such as hooded windmillgrass and Mormon-tea. The unit can support scattered fourwing saltbush. Plants in the potential plant community that increase because of overgrazing are sand sagebrush, small soapweed, and pale wolfberry.

Deferment from grazing during the growing season is needed to maintain or improve the vigor and reproduction of desirable forage plants such as black

grama and mesa dropseed. Rangeland seeding is not suitable because of the low precipitation. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage. This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The average annual production of air-dry vegetation on this unit ranges from 1,100 pounds per acre in favorable years to 600 pounds in unfavorable years.

PpA—Poquita loam. This deep, well drained soil is on alluvial side slopes in the western part of the survey area. It formed in calcareous alluvium. Slope is 0 to 3 percent. Areas are irregular in shape and are 500 to 3,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,900 to 4,500 feet. The average annual precipitation is about 13 to 14 inches, the average annual air temperature is about 59 to 61 degrees F, and the average frost-free period is 195 to 205 days.

Typically, the surface layer is brown loam about 6 inches thick. The subsoil is light brown clay loam about 15 inches thick. The substratum to a depth of 60 inches or more is pink and reddish yellow clay loam.

Included in this unit are small areas of Conger and Bascom soils on low ridges, a soil that is similar to this Poquita soil but has sandstone or shale fragments throughout and is on low ridges; Milner and Reeves, moist, soils on low ridges; and Alama soils and a deep, dark-colored soil in depressional areas. Included areas make up about 20 percent of the total acreage.

Permeability of the Poquita soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly tobosa, black grama, blue grama, and alkali sacaton. The present vegetation in most areas is mainly tobosa, blue grama, sand dropseed, and silver bluestem. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Plants in the potential plant community that increase because of overgrazing are tobosa and burrograss. Mesquite and walkingstick cholla readily invade the unit as the plant community deteriorates. Rangeland seeding is not suitable because of the low precipitation.

The average annual production of air-dry vegetation on this unit ranges from 1,200 pounds per acre in favorable years to 650 pounds in unfavorable years.

PrA—Portales fine sandy loam, 0 to 2 percent slopes. This deep, well drained soil is on high plains in the eastern part of the survey area. It formed in calcareous alluvium. Areas are elongated or irregular in shape and are 200 to 1,500 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,400 to 4,500 feet. The average annual precipitation is 14 to 15 inches, the average annual air temperature is 58 to 60 degrees F, and the average frost-free period is 185 to 195 days.

Typically, the surface layer is very dark grayish brown fine sandy loam and dark grayish brown loam about 17 inches thick. The subsoil is 35 inches thick. The upper 18 inches of the subsoil is brown and light gray clay loam, and the lower 17 inches is pink sandy clay loam. The substratum to a depth of 60 inches or more is reddish yellow sandy clay loam.

Included in this unit are small areas of Faskin, Douro, and Kimbrough soils and a soil that has a zone that is high in content of calcium carbonate and is within 20 inches of the surface. Included areas make up about 30 percent of the total acreage.

Permeability of the Portales soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly blue grama, sideoats grama, black grama, and little bluestem. The unit supports important forage plants such as New Mexico feathergrass and winterfat. A plant in the potential plant community that increases because of overgrazing is tobosa. Mesquite readily invades the unit as the plant community deteriorates. Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as black grama, sideoats grama, and little bluestem. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The average annual production of air-dry vegetation on this unit ranges from 1,750 pounds per acre in favorable years to 800 pounds in unfavorable years.

PYB—Pyote-Faskin association, moderately undulating. This map unit is on high terraces in the eastern part of the survey area. Slope is 0 to 5 percent. Areas are irregular in shape and are 500 to 3,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,900 to 4,200 feet. The average annual precipitation is 13 to 14 inches, the average

annual air temperature is 59 to 61 degrees F, and the average frost-free period is 195 to 205 days.

This unit is 55 percent Pyote loamy fine sand, 0 to 5 percent slopes, and 35 percent Faskin loamy fine sand, 0 to 2 percent slopes. The Pyote soil is on ridges, and the Faskin soil is in depressional areas.

Included in this unit are small areas of Malstrom and Jalmar soils in depressional areas. Included areas make up about 10 percent of the total acreage.

The Pyote soil is deep and well drained. It formed in alluvial and eolian deposits. Typically, the surface layer is brown and yellowish red loamy fine sand about 21 inches thick. The subsoil is reddish brown fine sandy loam about 29 inches thick. The substratum to a depth of 60 inches or more is light reddish brown loamy fine sand.

Permeability of the Pyote soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

The Faskin soil is deep and well drained. It formed in alluvial and eolian deposits. Typically, the surface layer is brown and light brown loamy fine sand about 16 inches thick. The subsoil is yellowish red and pink sandy clay loam about 44 inches thick or more.

Permeability of the Faskin soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is very high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly little bluestem, sand bluestem, black grama, and New Mexico feathergrass. Plants in the potential plant community that increase because of overgrazing are sand sagebrush, broom snakeweed, and small soapweed. Shinnery oak readily invades as the plant community deteriorates. In areas where shinnery oak is dominant, livestock should be removed when the shinnery oak is in late bud or early leaf stage because of its toxicity during this period.

Grazing management should be designed to increase the vigor, productivity, and reproduction of little bluestem and New Mexico feathergrass. Mechanical brush control and mechanical treatment are not suitable because of the hazard of soil blowing. Rangeland seeding is not suitable because of the low precipitation. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage. This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The average annual production of air-dry vegetation on this unit ranges from 3,000 pounds per acre in favorable years to 1,500 pounds in unfavorable years.

RAA—Ratliff-Portales, dry association, gently undulating. This map unit is on alluvial side slopes below breaks on high plains in the eastern part of the survey area. Slope is 0 to 2 percent. This unit consists of an area that is oblong in shape and is about 2,893 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,100 to 4,300 feet. The average annual precipitation is about 13 to 14 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 195 to 205 days.

This unit is 60 percent Ratliff fine sandy loam, 0 to 2 percent slopes, and 30 percent Portales loam, dry, 0 to 2 percent slopes. The Ratliff soil is on low ridges, and the Portales soil is in depressional areas.

Included in this unit are small areas of an undulating gravelly soil on ridges and a deep, dark-colored soil in depressional areas. Included areas make up about 10 percent of the total acreage.

The Ratliff soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is brown and light brown fine sandy loam about 11 inches thick. The subsoil is 49 inches thick or more. The upper 15 inches of the subsoil is pink sandy clay loam, and the lower 34 inches or more is pink clay loam.

Permeability of the Ratliff soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Portales soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is brown loam about 10 inches thick. The subsoil is 23 inches thick. The upper 9 inches of the subsoil is brown loam, and the lower 14 inches is light brown clay loam. The substratum to a depth of 60 inches or more is pink clay loam.

Permeability of the Portales soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Ratliff soil is mainly black grama, little bluestem, plains bristlegrass, and yucca. If the plant cover is disturbed, protection from flooding is needed to control gullying, streambank cutting, and sheet erosion.

The potential plant community on the Portales soil is mainly blue grama, sideoats grama, black grama, and little bluestem. As the plant community deteriorates, the more palatable and desirable forage plants such as black grama decrease and there is an increase in plants such as sand dropseed, threeawns, broom snakeweed, and tobosa, which normally occur only in small amounts. Mesquite readily invades as the plant community deteriorates.

Areas of this unit that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

The average annual production of air-dry vegetation on this unit ranges from 1,600 pounds per acre in favorable years to 800 pounds in unfavorable years.

RBA—Ratliff-Redona association, gently undulating. This map unit is on high terraces in the eastern part of the survey area. Slope is 0 to 2 percent. Areas are irregular in shape and are 100 to 3,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,800 to 4,300 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 195 to 205 days.

This unit is 45 percent Ratliff fine sandy loam, 0 to 2 percent slopes, and 35 percent Redona fine sandy loam, 0 to 1 percent slopes. The Ratliff soil is on alluvial side slopes and low ridges, and the Redona soil is in depressional areas.

Included in this unit are small areas of Blakeney soils on low ridges, Canez soils in depressional areas, and soils that have a loam surface layer. Included areas make up about 20 percent of the total acreage.

The Ratliff soil is deep and well drained. It formed in calcareous alluvium. The surface layer is brown fine sandy loam about 6 inches thick. The subsoil is 54 inches thick or more. The upper 19 inches of the subsoil is dark yellowish brown loam and brown sandy clay loam, and the lower 35 inches or more is light brown sandy clay loam and pink clay loam.

Permeability of the Ratliff soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

The Redona soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is reddish brown fine sandy loam about 12 inches thick. The subsoil is reddish brown and light reddish brown sandy clay loam 48 inches thick or more.

Permeability of the Redona soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly black grama, hooded windmillgrass, little bluestem, and blue grama. The present vegetation in most areas is mainly blue grama, sand dropseed, plains bristlegrass, and silver bluestem. Mesquite readily invades this unit as the plant community deteriorates. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Livestock grazing should be managed to protect the unit from excessive

erosion. Rangeland seeding is not suitable because of the low precipitation.

The average annual production of air-dry vegetation on this unit ranges from 1,600 pounds per acre in favorable years to 800 pounds in unfavorable years.

RCA—Ratliff-Redona association, loam surface, gently undulating. This map unit is on high terraces in the eastern part of the survey area. Slope is 0 to 2 percent. Areas are irregular in shape and are 100 to 2,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,800 to 4,300 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 195 to 205 days.

This unit is 45 percent Ratliff loam, 0 to 2 percent slopes, and 35 percent Redona loam, 0 to 1 percent slopes. The Ratliff soil is on alluvial side slopes and low ridges, and the Redona soil is in depressional areas.

Included in this unit are small areas of Blakeney soils on low ridges, Canez soils in depressional areas, and Tucumcari soils in depressional areas and on the lower alluvial side slopes. Included areas make up about 20 percent of the total acreage.

The Ratliff soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is reddish brown loam about 8 inches thick. The subsoil is 52 inches thick or more. The upper 30 inches of the subsoil is light reddish brown sandy clay loam, and the lower 22 inches or more is pink sandy clay loam.

Permeability of the Ratliff soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Redona soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is reddish brown loam about 12 inches thick. The subsoil is reddish brown and light reddish brown sandy clay loam about 48 inches thick or more.

Permeability of the Redona soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly blue grama, tobosa, black grama, and plains bristlegrass. The present vegetation in most areas is mainly blue grama, sand dropseed, mesquite, and tobosa. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Brush management improves deteriorated

areas of rangeland that are producing more woody shrubs than were present in the potential plant community. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage.

The average annual production of air-dry vegetation on this unit ranges from 1,600 pounds per acre in favorable years to 700 pounds in unfavorable years.

RDB—Reagan-Conger association, moderately undulating. This map unit is on uplands, mainly in the southwestern part of the survey area. Slope is 0 to 5 percent. Areas are irregular in shape and are 200 to 3,500 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,900 to 4,600 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 58 to 60 degrees F, and the average frost-free period is 190 to 200 days.

This unit is 50 percent Reagan silt loam, 0 to 2 percent slopes, and 35 percent Conger loam, 0 to 5 percent slopes. The Reagan soil is on alluvial fans and in depressional areas, and the Conger soil is on knolls and ridges.

Included in this unit are small areas of a deep, dark-colored soil in depressional areas and along drainageways, a soil that has a high content of calcium carbonate at a depth of less than 20 inches, and a soil that is moderately deep to indurated caliche and is on ridges and knolls. Included areas make up about 15 percent of the total acreage.

The Reagan soil is deep and well drained. It formed in calcareous alluvium derived dominantly from limestone. Typically, the surface layer is yellowish brown silt loam and brown silty clay loam about 10 inches thick. The subsoil is 34 inches thick. The upper 14 inches of the subsoil is brown silty clay loam, and the lower 20 inches is light brown and pink silty clay loam. The substratum to a depth of 60 inches or more is pink silty clay loam.

Permeability of the Reagan soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Conger soil is shallow and well drained. It formed in calcareous alluvium. Typically, the surface layer is brown loam about 2 inches thick. The subsoil is brown loam about 7 inches thick. The substratum is brown cobbly loam about 3 inches thick. Indurated caliche is at a depth of 12 inches.

Permeability of the Conger soil is moderate. Available water capacity is very low. Effective rooting depth is about 8 to 20 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Reagan soil is mainly blue grama, tobosa, black grama, and sand

dropseed. Plants in the potential plant community that increase because of overgrazing are tobosa and silver bluestem. This soil receives runoff from adjoining areas, resulting in increased production and higher palatability of the forage; therefore, the soil is often overgrazed. Rangeland seeding is limited because of the low precipitation.

The potential plant community on the Conger soil is mainly black grama, blue grama, sideoats grama, and New Mexico feathergrass. Rangeland improvement practices such as livestock water pipelines, fences, and water impoundment facilities are difficult to install because of the shallow depth to caliche. Rangeland seeding is not suitable because of the shallow depth and low precipitation.

The average annual production of air-dry vegetation on this unit ranges from 1,600 pounds per acre in favorable years to 700 pounds in unfavorable years.

ReA—Reakor silt loam, 0 to 1 percent slopes. This deep well drained soil is on alluvial side slopes in the south-central part of the survey area. It formed in calcareous alluvium derived dominantly from limestone. Areas are elongated or irregular in shape and are 5 to 500 acres in size. The vegetation in areas not cultivated is mainly grasses and shrubs. Elevation is 3,550 to 3,700 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is brown silt loam about 19 inches thick. The substratum to a depth of 60 inches or more is strong brown silty clay loam.

Included in this unit are small areas of Alama, Reeves, Reakor Variant, and Upton soils. Also included are small areas of Reakor silt loam, 1 to 3 percent slopes. Included areas make up about 15 percent of the total acreage.

Permeability of the Reakor soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used as irrigated cropland, hayland, pastureland, urban development, and wildlife habitat. The main crops are alfalfa, cotton (fig. 4), and grain sorghum. Among the other crops grown is small grain. Some areas are used for permanent pasture.

This unit is well suited to all crops commonly grown in the survey area. It is limited mainly by poor tilth.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. If irrigation is planned, the quality of water should be tested. Using water of poor quality may necessitate an adjustment in the types of crops planted. Irrigation water should be applied at a rate that insures optimum production without



Figure 4.—Cotton on Reakor silt loam, 0 to 1 percent slopes.

increasing deep percolation, runoff, and erosion. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion. Leveling helps to insure the uniform application of water.

The organic matter content of the soil can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes an adequate amount of soil improving crops such as alfalfa and high residue crops. A cropping system that returns a high residue crop to the soil once every 4 years helps to maintain soil tilth. If legumes or grasses are grown in the cropping system, species should be selected that can be maintained on the land for at least 3 years. Fertilizer commonly is used. The application of fertilizer should be

based on needs of the crops grown. Using management that maintains optimum vigor and quality of forage plants is a good practice. Tillage should be kept to a minimum.

Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Soil blowing can also be reduced by keeping the soil rough and cloddy when it is not protected by vegetation and by seeding disturbed areas to native or tame pasture plants.

If this unit is used for urban development, the main limitations are the hazard of soil blowing during construction and moderate shrink-swell potential. Preserving as much of the existing plant cover as possible during construction and promptly revegetating disturbed areas around construction sites help to control water erosion and soil blowing. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings

help to prevent structural damage because of shrinking and swelling.

ReB—Reakor silt loam, 1 to 3 percent slopes. This deep, well drained soil is on alluvial side slopes in the south-central part of the survey area. It formed in calcareous alluvium derived dominantly from limestone. Areas are elongated or irregular in shape and are 20 to 225 acres in size. The vegetation in areas not cultivated is mainly grasses and shrubs. Elevation is 3,550 to 3,700 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is brown, light brown, and strong brown silt loam about 28 inches thick. The substratum to a depth of 60 inches or more is light brown silt loam.

Included in this unit are small areas of Reakor Variant loam in slightly convex areas, Upton gravelly loam on small knolls, and Alama and Reeves soils. Also included are small areas of Reakor silt loam, 0 to 1 percent slopes. Included areas make up about 10 percent of the total acreage.

Permeability of the Reakor soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for irrigated crops, hay and pasture, urban development, and wildlife habitat. The main crops are alfalfa, cotton, and grain sorghum. Among the other crops grown are small grain and permanent pasture.

This unit is suited to all crops commonly grown in the survey area. It is limited mainly by poor tilth and slope.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to the unit. The method used generally is governed by the crop grown. If irrigation is planned, the quality of water should be tested. Using water of poor quality may necessitate an adjustment in the types of crops planted. Irrigation water needs to be applied at a rate that insures optimum production without increasing deep percolation, runoff, and erosion. It should be applied in amounts sufficient to wet the root zone but in amounts small enough to minimize the leaching of plant nutrients. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion. Leveling helps to insure the uniform application of water.

The organic matter content of the soil can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes an adequate amount of soil improving crops such as alfalfa

and high residue crops. A cropping system that returns a high residue crop to the soil once every 3 years reduces runoff and helps to maintain soil tilth. If legumes or grasses are grown in the cropping system, species should be selected that can be maintained on the land for at least 3 years. Fertilizer commonly is used. The application of fertilizer should be based on the needs of the crops grown. Using management that maintains optimum vigor and quality of forage plants is a good practice.

Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Soil blowing can also be reduced by returning crop residue to the soil, practicing minimum tillage, keeping the soil rough and cloddy when it is not protected by vegetation, and seeding disturbed areas to native or tame pasture plants.

If this unit is used for urban development, the main limitations are the hazard of soil blowing during construction and, in some areas, moderate shrink-swell potential. Preserving as much of the existing plant cover as possible during construction and promptly revegetating disturbed areas around construction sites help to control water erosion and soil blowing. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling.

REB—Reakor silt loam, 0 to 3 percent slopes. This deep, well drained soil is on alluvial slopes and in broad valleys in the south-central part of the survey area. It formed in alluvium and some eolian material derived dominantly from limestone. Areas are elongated or irregular in shape and are 3,000 to 12,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,600 to 4,200 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

Typically, the surface layer is pale brown and yellowish brown silt loam about 7 inches thick. The subsoil is 31 inches thick. The upper 15 inches of the subsoil is light yellowish brown silty clay loam, and the lower 16 inches is pink silty clay loam. The substratum to a depth of 60 inches or more is light brown and pink silty clay loam.

Included in this unit are small areas of Upton and Reakor Variant soils on knolls and ridges, soils that are moderately deep to indurated caliche and are on knolls and ridges, and deep, dark-colored soils in drainageways and depressional areas. Also included are small areas of soils that do not have distinct layers of calcium carbonate accumulation and are on alluvial side slopes and in drainageways. Included areas make up about 15 percent of the total acreage.

Permeability of the Reakor soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly tobosa, black grama, blue grama, and fourwing saltbush. The unit supports important forage plants such as Mormon-tea. As the plant community deteriorates, the more palatable and desirable forage plants such as black grama decrease and there is an increase in plants such as burrograss, poverty threawn, sand dropseed, and broom snakeweed, which normally occur only in small amounts. Walkingstick cholla readily invades as the plant community further deteriorates. Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as black grama. Rangeland seeding is not suitable because of the low precipitation.

The average annual production of air-dry vegetation on this unit ranges from 1,200 pounds per acre in favorable years to 650 pounds in unfavorable years.

RFB—Reakor-Bigetty association, moderately undulating. This map unit is on alluvial side slopes and bottom lands in the south-central part of the survey area. Slope is 0 to 3 percent. Areas are elongated in shape and are 150 to 2,500 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,600 to 4,200 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

This unit is 45 percent Reakor silt loam, 0 to 3 percent slopes, and 40 percent Bigetty silt loam, 0 to 1 percent slopes. The Reakor soil is on alluvial side slopes and low terraces, and the Bigetty soil is on bottom lands and in depressional areas.

Included in this unit are small areas of Upton soils on knolls and ridges; Pecos soils on bottom lands, and soils that are coarser textured than the Reakor soil. Also included are small areas of deep, gravelly soils adjacent to drainageways. Included areas make up about 15 percent of the total acreage.

The Reakor soil is deep and well drained. It formed in calcareous alluvium derived dominantly from limestone. Typically, the surface layer is brown and yellowish brown silt loam about 9 inches thick. The subsoil is 31 inches thick. The upper 14 inches of the subsoil is brown silt loam, and the lower 17 inches is light brown silty clay loam. The substratum to a depth of 60 inches or more is light brown and pink silty clay loam.

Permeability of the Reakor soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of

water erosion is moderate. The hazard of soil blowing is high.

The Bigetty soil is deep and well drained. It formed in alluvium. Typically, the surface layer is brown silt loam about 4 inches thick. The subsoil is brown silt loam about 34 inches thick. The substratum to a depth of 60 inches or more is dark grayish brown silty clay loam.

Permeability of the Bigetty soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high. The Bigetty soil is rarely flooded, but some areas are inundated for short periods of time during flash floods. Damage to the soil generally is minimal.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Reakor soil is mainly blue grama, tobosa, alkali sacaton, and vine-mesquite. The present vegetation in most areas is mainly tobosa, sand dropseed, silver bluestem, and mesquite. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. A plant in the potential plant community that increases because of overgrazing is burrograss. Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as blue grama.

The average annual production of air-dry vegetation on this soil ranges from 1,200 pounds per acre in favorable years to 650 pounds in unfavorable years.

The potential plant community on the Bigetty soil is mainly giant sacaton, alkali sacaton, tobosa, and vine-mesquite. The present vegetation in most areas is mainly giant sacaton and tobosa. A plant in the potential plant community that increases because of overgrazing is tobosa. Mesquite readily invades. Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as giant sacaton and alkali sacaton. Rangeland seeding is not suitable because of the low precipitation. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage.

The average annual production of air-dry vegetation on this soil ranges from 4,800 pounds per acre in favorable years to 2,500 pounds in unfavorable years.

RgB—Reakor Variant loam. This deep, well drained soil is on terraces and ridges in the south-central part of the survey area. It formed in calcareous alluvium derived dominantly from limestone. Slope is 0 to 3 percent. Areas are irregular in shape and are 5 to 100 acres in size. The vegetation in areas not cultivated is mainly grasses and shrubs. Elevation is 3,600 to 3,750 feet. The

average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

Typically, the surface layer is light brown loam about 8 inches thick. The subsoil is 30 inches thick. The upper 22 inches of the subsoil is light brown loam, and the lower 8 inches is pink very gravelly clay loam. The upper 17 inches of the substratum is pink gravelly clay loam, and the lower part to a depth of 60 inches or more is pink clay loam.

Included in this unit are small areas of Reakor, Alama, and Reeves soils. Included areas make up about 10 percent of the total acreage.

Permeability of the Reakor Variant soil is moderate. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for irrigated crops, hay and pasture, urban development, and wildlife habitat. The main crops are alfalfa, cotton, and grain sorghum. Among the other crops grown are small grain and permanent pasture.

This unit is well suited to all crops commonly grown in the survey area.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to the unit. The method used generally is governed by the crop grown. If irrigation is planned, the quality of water should be tested because poor water quality may necessitate an adjustment in the types of crops planted. Irrigation water needs to be applied at a rate that insures optimum production without increasing deep percolation, runoff, and erosion. It should be applied in amounts sufficient to wet the root zone but in amounts small enough to minimize the leaching of plant nutrients. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Leveling helps to insure the uniform application of water. Excessive leveling cuts should be avoided to prevent exposure of the very gravelly substratum. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

The organic matter content of the soil can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes an adequate amount of soil improving crops such as alfalfa and high residue crops. A cropping system that returns a high residue crop to the soil once every 3 years reduces runoff. If legumes or grasses are grown in the cropping system, species should be selected that can be maintained on the land for at least 3 years. Fertilizer commonly is used. The application of fertilizer should be based on the needs of the crops grown. Using management that maintains optimum vigor and quality of forage plants is a good practice.

Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Soil blowing can also be reduced by keeping the soil rough and cloddy when it is not protected by vegetation, seeding disturbed areas to native or tame pasture plants, and keeping tillage to a minimum.

If this unit is used for urban development, the main limitations are the hazard of soil blowing during construction and moderate shrink-swell potential. Preserving as much of the existing plant cover as possible during construction and promptly revegetating disturbed areas around construction sites help to control water erosion and soil blowing. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling.

RHA—Redona-Canez association, gently undulating. This map unit is on high terraces in the north-central and eastern parts of the survey area. Slope is 0 to 2 percent. Areas are irregular in shape and are 100 to 3,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,800 to 4,300 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is about 59 to 61 degrees F, and the average frost-free period is 195 to 205 days.

This unit is 60 percent Redona fine sandy loam, 0 to 2 percent slopes, and 35 percent Canez fine sandy loam, 0 to 1 percent slopes. The Redona soil is on low ridges, and the Canez soil is in depressional areas.

Included in this unit are small areas of Ratliff and Blakeney soils on low ridges. Included areas make up about 5 percent of the total acreage.

The Redona soil is deep and well drained. It formed in alluvium derived dominantly from calcareous material. Typically, the surface layer is reddish brown fine sandy loam about 6 inches thick. The subsoil is reddish brown and light reddish brown sandy clay loam about 34 inches thick. The substratum to a depth of 60 inches or more is pink sandy clay loam.

Permeability of the Redona soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Canez soil is deep and well drained. It formed in alluvium. Typically, the surface layer is brown fine sandy loam about 8 inches thick. The subsoil is yellowish red and red sandy clay loam about 52 inches thick.

Permeability of the Canez soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly little bluestem, black grama, plains bristlegrass, and yucca. The unit supports important forage plants such as Mormon-tea. Yucca is scattered throughout the plant community. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Sand sagebrush readily invades as the plant community deteriorates.

Deferment from grazing during the growing season is needed to maintain or improve the vigor and reproduction of desirable forage plants such as black grama and little bluestem. Rangeland seeding is not suitable because of the low precipitation. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage.

The average annual production of air-dry vegetation on this unit ranges from 1,600 pounds per acre in favorable years to 800 pounds in unfavorable years.

RKA—Redona-Canez association, loam surface, gently undulating. This map unit is on high terraces in the eastern part of the survey area. Slope is 0 to 2 percent. Areas are irregular in shape and are 300 to 1,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,900 to 4,500 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is about 59 to 61 degrees F, and the average frost-free period is 195 to 205 days.

This unit is 60 percent Redona loam, 0 to 2 percent slopes, and 35 percent Canez loam, 0 to 1 percent slopes. The Redona soil is on low ridges, and the Canez soil is in depressional areas.

Included in this unit are small areas of Ratliff soils on low ridges and deep, dark-colored soils in depressional areas. Included areas make up about 5 percent of the total acreage.

The Redona soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is reddish brown loam about 7 inches thick. The subsoil is reddish brown and yellowish red clay loam about 53 inches thick or more.

Permeability of the Redona soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

The Canez soil is deep and well drained. It formed in alluvium. Typically, the surface layer is dark yellowish brown loam about 8 inches thick or more. The subsoil is brown sandy clay loam about 52 inches thick or more.

Permeability of the Canez soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly little bluestem, black grama, plains bristlegrass, and yucca. The unit supports important forage plants such as Mormon-tea. Yucca is scattered throughout the plant community. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Sand sagebrush readily invades the unit as the plant community deteriorates.

Deferment from grazing during the growing season is needed to maintain or improve the vigor and reproduction of desirable forage plants such as black grama and little bluestem. Rangeland seeding is not suitable because of the low precipitation. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage.

The average annual production of air-dry vegetation on this unit ranges from 1,600 pounds per acre in favorable years to 800 pounds in unfavorable years.

RmA—Reeves loam, 0 to 1 percent slopes. This well drained soil is on terraces in the south-central part of the survey area. The soil is moderately deep to gypsiferous layers. It formed in alluvium derived dominantly from calcareous material high in content of gypsum. Areas are elongated or irregular in shape and are 5 to 50 acres in size. The vegetation in areas not cultivated is mainly grasses and shrubs. Elevation is 3,550 to 3,700 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

Typically, the surface layer is brown loam about 8 inches thick. The subsoil is brown and light brown clay loam about 22 inches thick. The substratum to a depth of 60 inches or more is pink, gypsiferous clay loam.

Included in this unit are small areas of Milner and Reakor soils, soils that have a silty clay loam surface layer, and Reeves loam, 1 to 3 percent slopes. Included areas make up about 15 percent of the total acreage.

Permeability of the Reeves soil is moderate. Salinity is none to slight. Available water capacity is moderate. Effective rooting depth is 35 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for irrigated crops, hay and pasture, urban development, and wildlife habitat. The main crops

are alfalfa, cotton, and grain sorghum. Among the other crops grown are small grain and permanent pasture.

This unit is suited to all crops commonly grown in the survey area. It is limited mainly by moderate depth to gypsiferous material, moderate available water capacity, and salinity.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to the unit. The method used generally is governed by the crop grown. If irrigation is planned, the quality of water should be tested. Using water of poor quality may necessitate an adjustment in the types of crops planted. Irrigation water needs to be applied at a rate that insures optimum production without increasing deep percolation, runoff, and erosion. It should be applied in amounts sufficient to wet the root zone but in amounts small enough to minimize the leaching of plant nutrients. Leveling helps to insure the uniform application of water. Deep leveling cuts should be avoided because of the moderate depth to a layer of gypsum accumulation. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion. The soil in this unit tends to be droughty and to require frequent irrigation. Intensive management is required to reduce the salinity and maintain soil productivity.

The organic matter content of the soil can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes an adequate amount of soil improving crops such as alfalfa and high residue crops. A cropping system that returns a high residue crop to the soil once every 2 years helps to maintain soil tilth and a favorable water intake rate. If legumes or grasses are grown in the cropping system, species should be selected that can be maintained on the land for at least 3 years. Fertilizer commonly is used. The application of fertilizer should be based on the needs of the crops grown. Using management that maintains optimum vigor and quality of forage plants is a good practice.

Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Soil blowing can also be reduced by returning crop residue to the soil, practicing minimum tillage, keeping the soil rough and cloddy when it is not protected by vegetation, and seeding disturbed areas to native or tame pasture plants.

If this unit is used for urban development, the main limitations are moderate depth to gypsiferous material, moderate shrink-swell potential, salinity, and the risk of soil blowing during construction. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings

help to prevent structural damage because of shrinking and swelling. Excavation for houses and access roads in places exposes material that is highly susceptible to soil blowing. Preserving as much of the existing plant cover as possible during construction and promptly revegetating disturbed areas around construction sites help to control water erosion and soil blowing.

RmB—Reeves loam, 1 to 3 percent slopes. This well drained soil is on terraces in the south-central part of the survey area. The soil is moderately deep to gypsiferous layers. It formed in alluvium derived dominantly from loamy, calcareous material high in content of gypsum. Areas are elongated or irregular in shape and are 5 to 50 acres in size. The vegetation in areas not cultivated is mainly grasses and shrubs. Elevation is 3,550 to 3,700 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

Typically, the surface layer is brown loam about 6 inches thick. The subsoil is 19 inches thick. The upper 6 inches of the subsoil is brown clay loam, and the lower 13 inches is reddish yellow clay loam. The substratum to a depth of 60 inches or more is reddish yellow, gypsiferous clay loam.

Included in this unit are small areas of Milner and Reakor soils, soils that have a silty clay loam surface layer, and Reeves loam, 0 to 1 percent slopes. Included areas make up about 15 percent of the total acreage.

Permeability of the Reeves soil is moderate. Salinity is slight. Available water capacity is low. Effective rooting depth is 35 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for irrigated crops, hay and pasture, urban development, and wildlife habitat. The main crops are alfalfa, cotton, and grain sorghum. Among the other crops grown are small grain and pasture.

This unit is suited to all crops commonly grown in the survey area. It is limited mainly by slope, low available water capacity, moderate depth to gypsiferous material, and salinity.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to the unit. The method used generally is governed by the crop grown. If irrigation is planned, the quality of water should be tested. Using water of poor quality may necessitate an adjustment in the types of crops planted. Irrigation water should be applied at a rate that insures optimum production without increasing deep percolation, runoff, and erosion. Water should be applied in amounts sufficient to wet the root zone but in amounts small enough to minimize the leaching of plant nutrients. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Leveling helps to

insure the uniform application of water. Deep leveling cuts should be avoided because of the moderate depth to a layer of gypsum accumulation. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

The organic matter content of the soil can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes an adequate amount of soil improving crops such as alfalfa or high residue crops. A cropping system that returns a high residue crop to the soil once every 2 years reduces runoff and erosion. If legumes or grasses are grown in the cropping system, species should be selected that can be maintained on the land for at least 3 years. Fertilizer commonly is used. The application of fertilizer should be based on the needs of the crops grown. Using management that maintains optimum vigor and quality of forage plants is a good practice.

Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Soil blowing can also be reduced by keeping the soil rough and cloddy when it is not protected by vegetation, seeding disturbed areas to native or tame pasture plants, returning crop residue to the soil, and practicing minimum tillage.

If this unit is used for urban development, the main limitations are moderate depth to gypsiferous material, moderate shrink-swell potential, salinity, and the risk of soil blowing during construction. Piping and dissolving of the gypsum are potential limitations. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling. Excavation for houses and access roads in places exposes material that is highly susceptible to soil blowing. Preserving as much of the existing plant cover as possible during construction and promptly revegetating disturbed areas around construction sites help to control water erosion and soil blowing.

RNA—Reeves, moist-Milner-Hollomex, moist association, gently undulating. This map unit is on high terraces in the northern part of the survey area, west of the Pecos River. Slope is 0 to 3 percent. Areas are rectangular or irregular in shape and are 1,000 to 5,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,900 to 4,500 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 195 to 205 days.

This unit is 50 percent Reeves loam, 0 to 2 percent slopes, 20 percent Milner loam, 0 to 2 percent slopes, and 15 percent Hollomex loam, 0 to 3 percent slopes. The Reeves and Milner soils are in depressional areas

and on smooth side slopes, and the Hollomex soil is on low knolls and ridges.

Included in this unit are small areas of Poquita and Alama soils in depressional areas and on smooth side slopes; soils that are moderately deep and shallow to shaly material and are on low knolls and ridges; and exposed, unvegetated gypsiferous material on low knolls. Included areas make up about 15 percent of the total acreage.

The Reeves soil is deep and well drained. It formed in alluvium derived dominantly from calcareous material high in content of gypsum. Typically, the surface layer is light brown loam about 7 inches thick. The subsoil is yellowish red clay loam about 16 inches thick. The substratum to a depth of 60 inches or more is pink and red, gypsiferous loam.

Permeability of the Reeves soil is moderate. Salinity is slight. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Milner soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is reddish brown loam about 3 inches thick. The subsoil is light reddish brown clay loam about 11 inches thick. The substratum to a depth of 60 inches or more is pink, light reddish brown, and red, gypsiferous sandy clay loam.

Permeability of the Milner soil is moderate. Available water capacity is low. Effective rooting depth is about 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Hollomex soil is deep and well drained. It formed in calcareous alluvium and residuum. Typically, the surface layer is reddish brown loam about 5 inches thick. The substratum to a depth of 60 inches or more is pink, light reddish brown, and red, gypsiferous sandy clay loam.

Permeability of the Hollomex soil is moderate. Available water capacity is very low. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly blue grama, tobosa, black grama, and sand dropseed. As the plant community deteriorates, the more palatable and desirable forage plants such as blue grama decrease and there is an increase in plants such as ring muhly, burrograss, and broom snakeweed, which normally occur only in small amounts. Further deterioration results in the total domination of the plant community by mesquite, with very little production of grass. Deferment from grazing during the growing season is needed to maintain or improve the vigor and reproduction of desirable forage plants such as blue

grama and black grama. If the plant cover is disturbed, protection is needed to control gullying, streambank cutting, and sheet erosion. Earthen ponds are not suitable because of the moderate depth to gypsiferous material.

The average annual production of air-dry vegetation on this unit ranges from 1,600 pounds per acre in favorable years to 700 pounds in unfavorable years.

RoD—Roswell fine sand, 10 to 30 percent slopes.

This deep, excessively drained soil is on high terraces in the eastern part of the survey area. It formed in eolian deposits. Slope is 10 to 30 percent. Areas are elongated or irregular in shape and are 30 to 1,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,000 to 4,200 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 195 to 205 days.

Typically, the surface layer is pale brown and light yellowish brown fine sand about 19 inches thick. The substratum to a depth of 60 inches or more is light brown fine sand.

Included in this unit are small areas of nearly level Jalmar, Pyote, and Roswell soils in depressional areas. Included areas make up about 10 percent of the total acreage.

Permeability of the Roswell soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly sand bluestem, little bluestem, mesa dropseed, and shinnery oak. As the plant community deteriorates, the more palatable and desirable forage plants such as mesa dropseed and sand bluestem decrease and there is an increase in plants such as red threeawn, field sandbur, shinnery oak, and sand sagebrush, which normally occur only in small amounts. Further deterioration results in the total domination of the plant community by shinnery oak, with very little production of grass. In areas where shinnery oak is dominant, livestock should be removed when the shinnery oak is in late bud or early leaf stage because of its toxicity during this period.

Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as sand bluestem and little bluestem. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

The average annual production of air-dry vegetation on this unit ranges from 2,500 pounds per acre in favorable years to 1,100 pounds in unfavorable years.

RPD—Roswell-Jalmar fine sands, hilly. This map unit is on high terraces in the eastern part of the survey area. Slope is 0 to 25 percent. Areas are elongated or irregular in shape and are 200 to 2,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,900 to 4,100 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 195 to 205 days.

This unit is 60 percent Roswell fine sand, 2 to 25 percent slopes, and 35 percent Jalmar fine sand, 0 to 2 percent slopes. The Roswell soil is on hummocky sand dunes, and the Jalmar soil is in depressional areas and in interdunal areas (fig. 5).

Included in this unit are small areas of Malstrom, Faskin, and Pyote soils in depressional areas. Included areas make up about 5 percent of the total acreage.

The Roswell soil is deep and excessively drained. It formed in eolian deposits. Typically, the surface layer is yellowish brown and light yellowish brown fine sand about 15 inches thick. The substratum to a depth of 60 inches or more is light yellowish brown fine sand.

Permeability of the Roswell soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

The Jalmar soil is deep and well drained. It formed in alluvial and eolian deposits. Typically, the surface layer is brown, light brown, and reddish yellow fine sand about 34 inches thick. The subsoil is reddish yellow sandy clay loam 26 inches thick or more.

Permeability of the Jalmar soil is moderate. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

This unit is used for livestock grazing (fig. 6) and wildlife habitat.

The potential plant community on this unit is mainly sand bluestem, little bluestem, sand paspalum, and plains bristlegrass. As the plant community deteriorates, the more palatable and desirable forage plants such as sand bluestem and little bluestem decrease and there is an increase in plants such as poverty threeawn, sand sagebrush, small soapweed, and shinnery oak, which normally occur only in small amounts. Further deterioration results in the total domination of the plant community by shinnery oak, with very little production of grass. In areas where shinnery oak is dominant, livestock should be removed when the shinnery oak is in late bud or early leaf stage because of its toxicity during this period. Mesquite readily invades the unit. Rangeland improvement practices such as rangeland seeding and mechanical brush control are difficult to apply because of the hazard of soil blowing.

The average annual production of air-dry vegetation on this unit ranges from 2,500 pounds per acre in favorable years to 1,000 pounds in unfavorable years.



Figure 5.—Area of Roswell-Jalmar fine sands, hilly. The Roswell soil is on the dunes, and the Jalmar soil is in the interdunal areas.

ShA—Sharvana fine sandy loam, dry. This shallow, well drained soil is on high terraces in the eastern part of the survey area. It formed in calcareous alluvium. Slope is 0 to 2 percent. Areas are oblong in shape and are 150 to 1,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,800 to 4,000 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 195 to 205 days.

Typically, the surface layer is reddish brown fine sandy loam about 3 inches thick. The subsoil is reddish brown sandy clay loam about 11 inches thick. Indurated caliche is at a depth of 14 inches.

Included in this unit are small areas of Faskin, Ratliff, Blakeney, and Redona soils. Included areas make up about 10 percent of the total acreage.

Permeability of the Sharvana soil is moderate. Available water capacity is very low. Effective rooting depth is 8 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly sideoats grama, little bluestem, blue grama, and small soapweed. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Plants in the potential plant community that increase because of overgrazing are small soapweed, poverty threawn, and sand muhly. Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as sideoats grama and little bluestem. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage.

The average annual production of air-dry vegetation on this unit ranges from 1,500 pounds per acre in favorable years to 800 pounds in unfavorable years.



Figure 6.—Area of Roswell-Jalmar fine sands, hilly. Cattle congregated at water tub on Jalmar soil; Roswell soil on dunes in background.

SKC—Sharvana-Kimbrough-Ratliff, moist association, moderately sloping. This map unit is on high plains in the eastern part of the survey area. Slope is 0 to 15 percent. Areas are elongated or irregular in shape and are 320 to 3,700 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,600 to 4,700 feet. The average annual precipitation is 14 to 15 inches, the average annual air temperature is 58 to 60 degrees F, and the average frost-free period is 185 to 195 days.

This unit is 30 percent Sharvana loam, 0 to 1 percent slopes; 25 percent Kimbrough gravelly loam, 2 to 15 percent slopes; and 20 percent Ratliff loam, 0 to 1 percent slopes, moist. The Sharvana and Ratliff soils are intermingled on broad ridgetops, and the Kimbrough soil is on ridge sides.

Included in this unit are small areas of soils that are moderately deep to indurated caliche and are on broad ridgetops. Also included are small areas of cobbly soils that are moderately deep and deep to indurated caliche

and have slopes of more than 15 percent. Included areas make up about 25 percent of the total acreage.

The Sharvana soil is shallow and well drained. It formed in alluvium. Typically, the surface layer is reddish brown loam about 4 inches thick. The subsoil is reddish brown sandy clay loam about 12 inches thick. Indurated caliche is at a depth of 16 inches.

Permeability of the Sharvana soil is moderate. Available water capacity is very low. Effective rooting depth is 8 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

The Kimbrough soil is shallow and well drained. It formed in calcareous alluvium. Typically, the surface layer is dark brown gravelly loam about 8 inches thick. Indurated caliche is at a depth of 8 inches.

Permeability of the Kimbrough soil is moderate. Available water capacity is very low. Effective rooting depth is 4 to 17 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is moderate.

The Ratliff soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is brown loam about 6 inches thick. The subsoil is 54 inches thick or more. The upper 24 inches of the subsoil is brown sandy clay loam, and the lower 30 inches or more is light brown sandy clay loam.

Permeability of the Ratliff soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Sharvana and Kimbrough soils is mainly black grama, blue grama, sideoats grama, and New Mexico feathergrass. Plants in the potential plant community that increase because of overgrazing are blue grama, ring muhly, hairy tridens, and broom snakeweed. Rangeland seeding is not suitable because of the shallow soil depth and low precipitation. Mechanical brush control is not suitable. Rangeland improvement practices such as fences, livestock water pipelines, and water impoundment facilities are difficult to install because of the shallow depth to caliche. These soils have limited suitability for livestock watering ponds and other water impoundments because of the shallow depth to caliche.

The average annual production of air-dry vegetation on these soils ranges from 1,000 pounds per acre in favorable years to 450 pounds in unfavorable years.

The potential plant community on the Ratliff soil is mainly blue grama, tobosa, sand dropseed, and silver bluestem. The present vegetation in most areas is mainly blue grama, sand dropseed, yucca, and tobosa. The soil also supports important forage plants such as winterfat. Mesquite readily invades the soil as the plant community deteriorates. The Ratliff soil receives runoff from adjoining areas, resulting in increased production and palatability of the forage; therefore, the soil often is overgrazed. Rangeland seeding is suitable but is limited because of the low precipitation. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Loss of the surface layer results in a severe decrease in productivity and in the potential of the soil to produce forage.

The average annual production of air-dry vegetation on this soil ranges from 1,600 pounds per acre in favorable years to 700 pounds in unfavorable years.

Walkingstick cholla readily invades this unit as the plant community deteriorates.

SLA—Sharvana, dry-Redona association, gently undulating. This map unit is on high terraces in the eastern part of the survey area. Slope is 0 to 2 percent. Areas are oblong or irregular in shape and are 600 to 1,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,800 to 4,000 feet. The

average annual precipitation is 13 to 14 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 195 to 205 days.

This unit is 50 percent Sharvana fine sandy loam, 0 to 2 percent slopes, dry, and 40 percent Redona fine sandy loam, 0 to 2 percent slopes. The Sharvana soil is on low ridges, and the Redona soil is in depressional areas.

Included in this unit are small areas of Blakeney soils on low ridges, soils that are more than 20 inches deep to caliche and are on low ridges, and Ratliff and Canez soils in depressional areas. Included areas make up about 10 percent of the total acreage.

The Sharvana soil is shallow and well drained. It formed in alluvium. Typically, the surface layer is brown fine sandy loam about 3 inches thick. The subsoil is brown sandy clay loam about 11 inches thick. Indurated caliche is at a depth of 14 inches.

Permeability of the Sharvana soil is moderate. Available water capacity is very low. Effective rooting depth is 8 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Redona soil is deep and well drained. It formed in alluvium derived dominantly from loamy calcareous material. Typically, the surface layer is brown fine sandy loam about 7 inches thick. The subsoil is 53 inches thick or more. The upper 18 inches of the subsoil is reddish brown sandy clay loam, and the lower 35 inches or more is pink and light reddish brown sandy clay loam.

Permeability of the Redona soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Sharvana soil is mainly sideoats grama, little bluestem, blue grama, and small soapweed. The present vegetation in most areas is mainly blue grama, sand dropseed, small soapweed, and broom snakeweed. The soil supports important forage plants such as winterfat. Mesquite and catclaw acacia readily invade this soil as the plant community deteriorates. Rangeland seeding is not suitable because of the shallow depth and low precipitation. Rangeland improvement practices such as fences and livestock water pipelines are difficult to install because of the shallow depth to caliche.

The average annual production of air-dry vegetation on this soil ranges from 1,500 pounds per acre in favorable years to 800 pounds in unfavorable years.

The potential plant community on the Redona soil is mainly little bluestem, blue grama, black grama, and small soapweed. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that

the desired balance of preferred species is maintained in the plant community. Plants in the potential plant community that increase because of overgrazing are sand dropseed, ring muhly, blue grama, and sand sagebrush. Mesquite and catclaw readily invade this soil as the plant community deteriorates.

The average annual production of air-dry vegetation on this soil ranges from 1,600 pounds per acre in favorable years to 800 pounds in unfavorable years.

SMA—Sotim-Berino association, gently undulating.

This map unit is on terraces in the south-central part of the survey area. Slope is 0 to 2 percent. Areas are oblong or irregular in shape and are 100 to 600 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,700 to 3,800 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

This unit is 50 percent Sotim fine sandy loam, 0 to 2 percent slopes, and 35 percent Berino fine sandy loam, 0 to 1 percent slopes. The Sotim soil is on alluvial side slopes and low ridges, and the Berino soil is in depressional areas.

Included in this unit are small areas of Simona soils on low ridges and soils that do not have a layer of calcium carbonate accumulation and are in depressional areas. Included areas make up about 15 percent of the total acreage.

The Sotim soil is deep and well drained. It formed in calcareous alluvium. Typically, the surface layer is reddish brown fine sandy loam about 4 inches thick. The subsoil is reddish brown loam about 29 inches thick. The substratum to a depth of 60 inches or more is light reddish brown clay loam.

Permeability of the Sotim soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Berino soil is deep and well drained. It formed in alluvial and eolian deposits. Typically, the surface layer is reddish brown fine sandy loam about 10 inches thick. The subsoil is red sandy clay loam about 32 inches thick. The substratum to a depth of 60 inches or more is pink sandy clay loam.

Permeability of the Berino soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly black grama, little bluestem, mesa dropseed, and bush muhly. Fourwing saltbush is scattered throughout the plant community. If the rangeland is overgrazed, the

proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Severe deterioration of the plant community results in the total domination of the plant community by shinnery oak, with very little production of grass. In areas where shinnery oak is dominant, livestock should be removed when the shinnery oak is in late bud or early leaf stage because of its toxicity during this period.

Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Rangeland seeding is not suitable because of the low precipitation. Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as black grama.

The average annual production of air-dry vegetation on this unit ranges from 1,800 pounds per acre in favorable years to 650 pounds in unfavorable years.

SNB—Sotim-Simona association, moderately undulating. This map unit is on high terraces in the south-central part of the survey area. Slope is 0 to 5 percent. Areas are elongated or irregular in shape and are 200 to 3,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,700 to 3,800 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

This unit is 50 percent Sotim fine sandy loam, 0 to 2 percent slopes, and 35 percent Simona fine sandy loam, 2 to 5 percent slopes. The Sotim soil is on alluvial side slopes and in depressional areas, and the Simona soil is on low ridges.

Included in this unit are small areas of Dona Ana soils in depressional areas. Also included are small areas of Philder soils on the shoulders of ridges. Included areas make up about 15 percent of the total acreage.

The Sotim soil is deep and well drained. It formed in calcareous alluvial and eolian material. Typically, the surface layer is reddish brown fine sandy loam about 7 inches thick. The subsoil is reddish brown and light reddish brown loam about 23 inches thick. The substratum to a depth of 60 inches or more is pink clay loam.

Permeability of the Sotim soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Simona soil is shallow and well drained. It formed in calcareous alluvial and eolian material. Typically, the surface layer is reddish brown fine sandy loam about 7 inches thick. The subsoil is reddish brown gravelly fine sandy loam about 7 inches thick. Indurated caliche is at a depth of 14 inches.

Permeability of the Simona soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 7 to 20 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly black grama, blue grama, sand dropseed, and hooded windmillgrass. The present vegetation in most areas is mainly blue grama, sand dropseed, small soapweed, and common javalinabush. The unit also supports important forage plants such as Mormon-tea. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

Deferment from grazing during the growing season is needed to maintain or improve the vigor and reproduction of desirable forage plants such as black grama. Rangeland seeding is not suitable because of the low precipitation. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage. The Simona soil is not suited to livestock watering ponds and other water impoundments because of the shallow depth.

The average annual production of air-dry vegetation on this unit ranges from 1,050 pounds per acre in favorable years to 600 pounds in unfavorable years.

SOA—Stromal-Faskin-Malstrom fine sands, gently undulating. This map unit is on high terraces in the eastern part of the survey area. Slope is 0 to 2 percent. Areas are irregular in shape and are 500 to 2,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,000 to 4,100 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is about 195 to 205 days.

This unit is 50 percent Stromal fine sand, 0 to 2 percent slopes; 30 percent Faskin fine sand, 0 to 2 percent slopes; and 15 percent Malstrom fine sand, 0 to 2 percent slopes.

Included in this unit are small areas of Jalmar and Pyote soils intermingled with the Faskin soil and small areas of Roswell soils on dunes. Included areas make up about 5 percent of the total acreage.

The Stromal soil is deep and well drained. It formed in calcareous alluvial and eolian deposits. Typically, the surface layer is brown fine sand about 13 inches thick. The subsoil is about 12 inches thick. The upper 8 inches of the subsoil is brown loamy fine sand, and the lower 4 inches is brown fine sandy loam. The substratum to a depth of 60 inches or more is pinkish white loam.

Permeability of the Stromal soil is moderately rapid. Available water capacity is high. Effective rooting depth

is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

The Faskin soil is deep and well drained. It formed in alluvial and eolian deposits. Typically, the surface layer is brown and yellowish brown fine sand about 15 inches thick. The subsoil is 30 inches thick. The upper 5 inches of the subsoil is reddish brown fine sandy loam, and the lower 25 inches is yellowish red sandy clay loam. The substratum to a depth of 60 inches or more is white loam.

Permeability of the Faskin soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is very high.

The Malstrom soil is deep and well drained. It formed in calcareous alluvial and eolian deposits. Typically, the surface layer is brown fine sand about 9 inches thick. The subsoil is pale brown fine sand about 13 inches thick. The upper 4 inches of the substratum is very pale brown fine sandy loam, and the lower part to a depth of 60 inches or more is very pale brown loam.

Permeability of the Malstrom soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is very high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Stromal and Malstrom soils is mainly little bluestem, sideoats grama, sand bluestem, and New Mexico feathergrass. Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as little bluestem. Plants in the potential plant community that increase because of overgrazing are sand dropseed, sand sagebrush, and shinnery oak.

The average annual production of air-dry vegetation on these soils ranges from 1,600 pounds per acre in favorable years to 600 pounds in unfavorable years.

The potential plant community on the Faskin soil is mainly little bluestem, sand dropseed, black grama, and plains bristlégrass. The present vegetation in most areas is mainly sand dropseed, black grama, and sand sagebrush. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Shinnery oak readily invades the Faskin soil. In areas where shinnery oak is dominant, livestock should be removed when the shinnery oak is in late bud or early leaf stage because of its toxicity during this period.

The average annual production of air-dry vegetation on this soil ranges from 3,000 pounds per acre in favorable years to 1,500 pounds in unfavorable years.

Areas of this unit that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Loss of the surface layer results in a severe decrease in productivity and in the potential of the soils in this unit to produce forage. Deferment from grazing during the growing season is needed to maintain or improve the vigor and reproduction of desirable forage plants such as little bluestem.

SPA—Stromal-Pyote fine sands, gently undulating.

This map unit is on high terraces in the eastern part of the survey area. Slope is 0 to 2 percent. Areas are irregular in shape and are 100 to 1,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,000 to 4,100 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 195 to 205 days.

This unit is 50 percent Stromal fine sand, 0 to 2 percent slopes, and 40 percent Pyote fine sand, 0 to 1 percent slopes. The Stromal soil is on low ridges. The Pyote soil is mainly in depressional areas, but in some places it is on low ridges.

Included in this unit are small areas of Jalmar soils in depressional and smooth areas, Malstrom soils on low ridges, and Roswell soils in scattered areas. Included areas make up about 10 percent of the total acreage.

The Stromal soil is deep and well drained. It formed in calcareous alluvial and eolian deposits. Typically, the surface layer is brown and yellowish brown fine sand about 17 inches thick. The subsoil is 11 inches thick. The upper 7 inches of the subsoil is light yellowish brown loamy fine sand, and the lower 4 inches is very pale brown fine sandy loam. The upper 22 inches of the substratum is white fine sandy loam, and the lower part to a depth of 60 inches or more is very pale brown loamy fine sand.

Permeability of the Stromal soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

The Pyote soil is deep and well drained. It formed in alluvial and eolian deposits. Typically, the surface layer is brown and light brown fine sand and reddish yellow loamy fine sand about 27 inches thick. The subsoil is strong brown fine sandy loam about 15 inches thick. The substratum to a depth of 60 inches or more is pink loamy fine sand.

Permeability of the Pyote soil is moderately rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly little bluestem, sideoats grama, sand bluestem, and New Mexico feathergrass. Plants in the potential plant community that increase because of overgrazing are red threeawn, mesa dropseed, sand dropseed, and shinnery oak. Mesquite readily invades the entire unit as the plant community deteriorates, and shinnery oak readily invades the Stromal soil. In areas where shinnery oak is dominant, livestock should be removed when the shinnery oak is in late bud or early leaf stage because of its toxicity during this period. Deferment from grazing during the growing season is needed to maintain or improve the vigor and reproduction of desirable forage plants such as New Mexico feathergrass. Rangeland seeding is not suitable because of the low precipitation.

The average annual production of air-dry vegetation on this unit ranges from 3,000 pounds per acre in favorable years to 1,500 pounds in unfavorable years.

TAB—Threadgill-Asparas association, gently sloping. This map unit is on alluvial side slopes and in upland valleys in the northwestern part of the survey area. Slope is 0 to 5 percent. Areas are elongated in shape and are 200 to 2,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,300 to 4,600 feet. The average annual precipitation is 14 to 15 inches, the average annual air temperature is 54 to 56 degrees F, and the average frost-free period is 180 to 190 days.

This unit is 45 percent Threadgill silt loam, 0 to 5 percent slopes, and 40 percent Asparas loam, 0 to 2 percent slopes. The Threadgill soil is on alluvial side slopes, and the Asparas soil is in valleys and depressional areas.

Included in this unit are small areas of Darvey soils on alluvial side slopes, Pastura soils on low ridges, Gabaldon soils in depressional areas, and Pena soils on ridges. Included areas make up about 15 percent of the total acreage.

The Threadgill soil is deep and well drained. It formed in calcareous alluvium derived dominantly from limestone. Typically, the surface layer is dark grayish brown silt loam about 4 inches thick. The subsoil is yellowish brown and light yellowish brown silty clay loam about 26 inches thick. The substratum to a depth of 60 inches or more is light yellowish brown silty clay loam.

Permeability of the Threadgill soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Asparas soil is deep and well drained. It formed in alluvium derived dominantly from limestone. Typically, the surface layer is dark grayish brown loam about 4 inches thick. The subsoil is 34 inches thick. The upper

12 inches of the subsoil is very dark grayish brown loam, and the lower 22 inches is brown clay loam. The substratum to a depth of 60 inches or more is light brown clay loam.

Permeability of the Asparas soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly western wheatgrass, blue grama, bottlebrush squirreltail, and tobosa. The present vegetation in most areas is mainly tobosa, blue grama, silver bluestem, and walkingstick cholla. The unit supports important forage plants such as fourwing saltbush and winterfat. Walkingstick cholla readily invades the unit as the plant community deteriorates. Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as western wheatgrass, bottlebrush squirreltail, and blue grama. The Asparas soil receives runoff from adjoining areas, resulting in increased production and higher palatability of the forage; therefore, this soil is often overgrazed.

The average annual production of air-dry vegetation on this unit ranges from 1,500 pounds per acre in favorable years to 400 pounds in unfavorable years.

TGB—Threadgill-Gabaldon association, gently sloping. This map unit is on alluvial side slopes and in drainageways of the uplands in the northwestern part of the survey area. Slope is 0 to 5 percent. Areas are elongated in shape and are 100 to 5,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,200 to 4,500 feet. The average annual precipitation is 14 to 15 inches, the average annual air temperature is 54 to 56 degrees F, and the average frost-free period is 180 to 190 days.

This unit is 45 percent Threadgill silt loam, 0 to 5 percent slopes, and 35 percent Gabaldon silty clay loam, 0 to 1 percent slopes. The Threadgill soil is on alluvial side slopes, and the Gabaldon soil is in drainageways.

Included in this unit are small areas of soils that have a sandy subsoil and substratum and are on alluvial fans, dark-colored soils that have a fine sandy loam subsoil and substratum and are on the side slopes of limestone ridges, and soils that have a dark-colored surface layer and are intermingled with the Threadgill soil. Included areas make up about 20 percent of the total acreage.

The Threadgill soil is deep and well drained. It formed in calcareous alluvium derived dominantly from limestone. Typically, the surface layer is dark yellowish brown silt loam about 5 inches thick. The subsoil is brown and light brown silty clay loam about 31 inches thick. The substratum to a depth of 60 inches or more is light brown silty clay loam.

Permeability of the Threadgill soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

The Gabaldon soil is deep and well drained. It formed in calcareous alluvium derived dominantly from limestone. Typically, the surface layer is dark grayish brown silty clay loam about 28 inches thick. The subsoil is brown silty clay loam about 12 inches thick. The substratum to a depth of 60 inches or more is brown silt loam.

Permeability of the Gabaldon soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high. The Gabaldon soil is rarely flooded, but some areas may be inundated for short periods of time during flash floods. Damage to the soil generally is minimal.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Threadgill soil is mainly western wheatgrass, blue grama, bottlebrush squirreltail, and tobosa. The average annual production of air-dry vegetation on this soil ranges from 1,500 pounds per acre in favorable years to 400 pounds in unfavorable years.

The potential plant community on the Gabaldon soil is mainly giant sacaton, alkali sacaton, vine-mesquite, and western wheatgrass. The average annual production of air-dry vegetation on this soil ranges from 2,500 pounds per acre in favorable years to 1,100 pounds in unfavorable years.

As the plant community on this unit deteriorates, the more palatable and desirable forage plants such as western wheatgrass and giant sacaton decrease and there is an increase in plants such as blue grama, tobosa, and mat muhly, which normally occur only in small amounts. Walkingstick cholla readily invades the unit as the plant community deteriorates. Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as western wheatgrass and giant sacaton. Livestock grazing should be managed to protect the unit from excessive erosion.

TOD—Torriorthents, moderately steep. These deep, well drained soils are on high escarpments in the eastern part of the survey area. They formed in colluvium. Slope is 15 to 25 percent. Areas are elongated or irregular in shape and are 150 to 2,500 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,300 to 4,700 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 195 to 205 days.

No single profile of Torriorthents is typical, but one commonly observed in the survey area has a surface layer of reddish brown gravelly fine sandy loam about 6 inches thick. The upper 14 inches of the substratum is reddish brown gravelly sandy clay loam, and the lower part to a depth of 60 inches or more is pink gravelly sandy clay loam.

Included in this unit are small areas of Ratliff soils in the more nearly level areas along escarpments, Kimbrough soils on the upper edges of escarpments, and Ima soils on toe slopes of escarpments. Included areas make up about 20 percent of the total acreage.

Permeability of the Torriorthents is moderate. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is slight.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly black grama, hairy grama, sand dropseed, and skunkbush sumac. The present vegetation in most areas is mainly hairy grama, juniper, skunkbush sumac, and catclaw acacia. Deterioration results in the total domination of the plant community by catclaw acacia and mesquite, with very little production of grass. The total plant production is barely adequate during normal years to protect the soil surface from erosion; therefore, a suitable grazing management program is to graze this unit only for short periods in fall following seasons of above normal production. Steepness of slope limits access by livestock and encourages overgrazing of the less sloping areas. Rangeland improvement practices such as livestock water pipelines and fences are difficult to install on Torriorthents because of the steepness of slope. Mechanical treatment is not practical because of rock fragments and the steepness of slope.

The average annual production of air-dry vegetation on this unit ranges from 1,000 pounds per acre in favorable years to 500 pounds in unfavorable years.

TPD—Torriorthents-Philder-Rock outcrop association, moderately steep. This map unit is on elevation breaks and high terraces in the south-central part of the survey area (fig. 7). Slope is 0 to 30 percent. Areas are long and narrow in shape and are 200 to 5,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,650 to 4,000 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

This unit is 40 percent Torriorthents, 2 to 30 percent slopes; 35 percent Philder very gravelly fine sandy loam, 0 to 5 percent slopes; and 20 percent Rock outcrop, 5 to 30 percent slopes. The Torriorthents and Rock outcrop are on elevation breaks and escarpments, and the Philder soil is on high terraces.

Included in this unit are small areas of Redona, Ratliff, and Blakeney soils on high terraces and Ima soils on elevation breaks and escarpments. Included areas make up about 5 percent of the total acreage.

The Torriorthents are shallow and well drained. They formed in calcareous alluvium and residuum. No single profile of Torriorthents is typical, but one commonly observed in the survey area has a surface layer of yellowish red fine sandy loam about 4 inches thick. The substratum is reddish brown fine sandy loam about 6 inches thick. Bedrock is at a depth of 10 inches.

Permeability of the Torriorthents is moderately rapid. Available water capacity is very low. Effective rooting depth is 6 to 20 inches. Runoff is medium to rapid, and the hazard of water erosion is high. The hazard of soil blowing is high.

The Philder soil is shallow and well drained. It formed in calcareous alluvium. Typically, the surface layer is brown gravelly fine sandy loam about 2 inches thick. The subsoil is brown very gravelly fine sandy loam about 6 inches thick. Indurated caliche is at a depth of 8 inches.

Permeability of the Philder soil is moderate. Available water capacity is very low. Effective rooting depth is 4 to 9 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is high.

Rock outcrop is exposures of sandstone. It supports little if any vegetation. Surface runoff is rapid.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly black grama, bush muhly, mesa dropseed, and plains bristleglass. The present vegetation in most areas is mainly sand dropseed, poverty threeawn, fluffgrass, and common javalinabush. This unit supports important forage plants such as Mormon-tea and small soapweed. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Plants in the potential plant community that increase because of overgrazing are blue grama, sand dropseed, and feather dalea. Broom snakeweed readily invades as the plant community deteriorates.

Steepness of slope limits access by livestock and results in overgrazing of the less sloping areas. Trails or walkways can be constructed in places to encourage livestock to graze in areas where access is limited. Mechanical treatment is not practical because of the shallow soil depth, steepness of slope, and rock fragments. Livestock grazing should be managed to protect the unit from excessive erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage. This unit is limited for livestock watering ponds and other water impoundments because of the shallow soil depth and steepness of slope. The total plant growth is barely



Figure 7.—Area of Torriorthents-Philder-Rock outcrop association, moderately steep, in background.

adequate during normal years to protect the soil surface from erosion; therefore, a suitable grazing management program is to graze this unit only for short periods in fall, following seasons of above normal production.

The average annual production of air-dry vegetation on this unit ranges from 1,050 pounds per acre in favorable years to 600 pounds in unfavorable years.

TuA—Tucumcari loam, 0 to 2 percent slopes. This deep, well drained soil is in valleys in the northern part of the survey area, west of the Pecos River. It formed in calcareous alluvium derived dominantly from red siltstone, sandstone, and shale and containing some accumulations of gypsum. Areas are elongated in shape and are 85 to 1,340 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,000 to 4,200

feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 195 to 205 days.

Typically, the surface layer is reddish brown loam about 5 inches thick. The subsoil is reddish brown clay loam about 43 inches thick. The substratum to a depth of 60 inches or more is light reddish brown clay loam.

Included in this unit are small areas of Redona soils on low ridges, Reeves soils on low ridges, and deep, dark-colored soils in depressional areas and drainageways. Included areas make up about 15 percent of the total acreage.

Permeability of the Tucumcari soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly blue grama, alkali sacaton, tobosa, and vine-mesquite. The present vegetation in most areas is mainly blue grama, tobosa, alkali sacaton, and mat muhly. The unit supports important forage plants such as fourwing saltbush. If the plant cover is disturbed, protection is needed to control gullying, streambank cutting, and sheet erosion. Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as alkali sacaton.

The average annual production of air-dry vegetation on this unit ranges from 1,500 pounds per acre in favorable years to 500 pounds in unfavorable years.

TvA—Tucumcari clay loam, 0 to 2 percent slopes.

This deep, well drained soil is in large depressional areas and basins in the eastern part of the survey area (fig. 8). It formed in alluvium derived dominantly from red siltstone, sandstone, and shale and containing some accumulations of gypsum. Areas are oblong in shape and are 50 to 1,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,900 to 4,100 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 185 to 195 days.

Typically, the surface layer is reddish brown and yellowish red clay loam about 8 inches thick. The subsoil is reddish brown clay about 25 inches thick. The



Figure 8.—Area of Tucumcari clay loam, 0 to 2 percent slopes, in lower areas in foreground.

substratum to a depth of 60 inches or more is yellowish red and red clay.

Included in this unit are small areas of Ratliff and Redona soils along the outer edges of the unit and a deep, dark-colored soil on low ridges. Included areas make up about 10 percent of the total acreage.

Permeability of the Tucumcari soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly blue grama, alkali sacaton, tobosa, and western wheatgrass. The present vegetation in most areas is mainly tobosa, blue grama, burrograss, and mat muhly. The unit supports important forage plants such as fourwing saltbush and winterfat. A plant in the potential plant community that increases because of overgrazing is tobosa. If the plant cover is disturbed, protection is needed to control gullying, streambank cutting, and sheet erosion. The unit receives runoff from adjoining areas, resulting in increased production and higher palatability of the forage; therefore, the unit is often overgrazed.

The average annual production of air-dry vegetation on this unit ranges from 1,500 pounds per acre in favorable years to 500 pounds in unfavorable years.

UaB—Upton gravelly loam, 0 to 5 percent slopes.

This shallow, well drained soil is on terraces, ridges, and knolls in the south-central part of the survey area. It formed in calcareous alluvial and eolian deposits. Areas are elongated or irregular in shape and are 30 to 1,500 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 4,000 to 4,300 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

Typically, the surface layer is brown gravelly loam about 4 inches thick. The subsoil is yellowish brown gravelly loam about 5 inches thick. Indurated caliche is at a depth of 9 inches.

Included in this unit are small areas of Reakor soils on alluvial side slopes, soils that are moderately deep to indurated caliche, Ector soils on back slopes, and Reakor Variant soils on side slopes. Included areas make up about 15 percent of the total acreage.

Permeability of the Upton soil is moderate. Available water capacity is very low. Effective rooting depth is 7 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

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

The potential plant community on this unit is mainly black grama, sideoats grama, catclaw mimosa, and Mormon-tea. The present vegetation in most areas is mainly blue grama, hairy tridens, common javalinabush, and broom snakeweed. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Plants in the potential plant community that increase because of overgrazing are blue grama, creosotebush, catclaw mimosa, and littleleaf sumac. Further deterioration results in the total domination of the plant community by creosotebush, with very little production of grass.

Rangeland improvement practices such as livestock water pipelines and water impoundment facilities are difficult to install on this unit because of rock fragments and the shallow depth to indurated caliche. Rangeland seeding is not suitable because of the low precipitation. The total plant growth is barely adequate during normal years to protect the soil surface from erosion; therefore, a suitable grazing management program is to graze this unit only for short periods in fall, following seasons of above normal production.

The average annual production of air-dry vegetation on this unit ranges from 800 pounds per acre in favorable years to 300 pounds in unfavorable years.

If this unit is used for urban development, the main limitation is shallow depth to indurated caliche.

UEC—Upton-Ector, dry association, moderately rolling. This map unit is on uplands in the south-central part of the survey area. Slope is 0 to 15 percent. Areas are elongated or irregular in shape and are 150 to 3,000 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,700 to 4,200 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

This unit is 55 percent Upton gravelly loam, 0 to 5 percent slopes, and 30 percent Ector very cobbly loam, 3 to 15 percent slopes, dry. The Upton soil is on knolls and ridges, and the Ector soil is on back slopes.

Included in this unit are small areas of Reakor soils in depressional areas and drainageways, soils that are moderately deep to indurated caliche and are on ridgetops and toe slopes, soils that have a light-colored surface layer, and Rock outcrop. Also included are small areas of Upton soils in which the indurated caliche overlies limestone. Included areas make up about 15 percent of the total acreage.

The Upton soil is shallow and well drained. It formed in calcareous alluvial and eolian deposits. Typically, the surface layer is brown gravelly loam about 4 inches thick. The subsoil is yellowish brown gravelly loam about

8 inches thick. Indurated caliche is at a depth of 12 inches.

Permeability of the Upton soil is moderate. Available water capacity is very low. Effective rooting depth is 7 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

The Ector soil is shallow and well drained. It formed in residuum derived dominantly from limestone. Typically, the surface layer is dark grayish brown and dark brown very cobbly loam about 8 inches thick. Limestone is at a depth of 8 inches.

Permeability of the Ector soil is moderate. Available water capacity is very low. Effective rooting depth is 4 to 20 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is slight.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly black grama, sideoats grama, hairy grama, and common javalinabush. The present vegetation in most areas is mainly hairy grama, creosotebush, catclaw mimosa, and broom snakeweed. Grazing management should be designed to increase the vigor, productivity, and reproduction of desirable forage plants such as black grama and sideoats grama. Plants in the potential plant community that increase because of overgrazing are hairy grama, creosotebush, and catclaw mimosa. Creosotebush readily invades the unit as the plant community further deteriorates.

Rangeland seeding is not suitable because of the shallow soil depth and low precipitation. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage. This unit has limited suitability for livestock watering ponds and other water impoundments because of the shallow soil depth. Rangeland improvement practices such as fences, livestock water pipelines, and water impoundment facilities are difficult to install because of the shallow depth to indurated caliche and limestone.

The average annual production of air-dry vegetation on this unit ranges from 800 pounds per acre in favorable years to 250 pounds in unfavorable years.

URB—Upton-Reakor association, moderately undulating. This map unit is on terraces in the south-central part of the survey area. Slope is 0 to 5 percent. Areas are irregular or elongated in shape and are 500 to 1,500 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,600 to 4,100 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

This unit is 45 percent Upton gravelly loam, 0 to 5 percent slopes, and 40 percent Reakor silt loam, 0 to 3 percent slopes. The Upton soil is on knolls and ridges,

and the Reakor soil is on alluvial side slopes and in depressional areas.

Included in this unit are small areas of Reakor Variant soils on alluvial side slopes, Ector soils on knolls and ridges, and soils that are moderately deep to indurated caliche and are on knolls and ridges. Also included are small areas of Bigetty soils along drainageways and in depressional areas. Included areas make up about 15 percent of the total acreage.

The Upton soil is shallow and well drained. It formed in calcareous alluvial and eolian deposits. Typically, the surface layer is brown gravelly loam about 5 inches thick. The subsoil is light brown cobbly loam about 5 inches thick. Indurated caliche is at a depth of 10 inches.

Permeability of the Upton soil is moderate. Available water capacity is very low. Effective rooting depth is 7 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

The Reakor soil is deep and well drained. It formed in calcareous alluvium derived dominantly from limestone. Typically, the surface layer is yellowish brown and brown silt loam about 14 inches thick. The subsoil is light brown and brown silt loam about 22 inches thick. The upper 11 inches of the substratum is pink silt loam, and the lower part to a depth of 60 inches or more is pink silty clay loam.

Permeability of the Reakor soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on the Upton soil is mainly black grama, sideoats grama, hairy grama, and catclaw mimosa. The present vegetation in most areas is mainly hairy grama, catclaw mimosa, fluffgrass, and creosotebush. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Rangeland improvement practices such as fences, livestock water pipelines, and water impoundment facilities are difficult to install on this soil because of the shallow depth to indurated caliche.

The average annual production of air-dry vegetation on this soil ranges from 800 pounds per acre in favorable years to 250 pounds in unfavorable years.

The potential plant community on the Reakor soil is mainly blue grama, tobosa, alkali sacaton, and fourwing saltbush. The present vegetation in most areas is mainly blue grama, tobosa, mesquite, and broom snakeweed. The Reakor soil receives runoff from adjoining areas, resulting in increased production and higher palatability

of the forage; therefore, the soil is often overgrazed. Mesquite readily invades this soil.

The average annual production of air-dry vegetation on this soil ranges from 1,200 pounds per acre in favorable years to 650 pounds in unfavorable years.

As the plant community deteriorates, walkingstick cholla readily invades the unit. Rangeland seeding is not suitable because of the low precipitation. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage.

USA—Ustifluvents, frequently flooded, nearly level.

These deep, somewhat poorly drained, frequently flooded soils are on flood plains along the Pecos River. They formed in alluvium. Slope is 0 to 2 percent. Areas are long and narrow in shape and are 100 to 2,000 acres in size. The native vegetation is mainly brush. Elevation is 3,500 to 3,700 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

No single profile of Ustifluvents is typical, but one commonly observed in the survey area has a surface layer of brown loam about 12 inches thick. The substratum to a depth of 60 inches or more is highly stratified, but it is dominantly strong brown very fine sandy loam, light brown and strong brown loamy fine sand, and brown silty clay loam.

Included in this unit are small areas of deep, clayey soils and deep, sandy soils on flood plains. Included areas make up about 10 percent of the total acreage.

Permeability of the Ustifluvents is slow to moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high. These soils are subject to frequent periods of flooding in spring and summer.

This unit is used for wildlife habitat.

YtC—Yturbide loamy sand, 7 to 13 percent slopes.

This deep, excessively drained soil is on terrace fronts along the Pecos River, in the south-central part of the survey area. It formed in alluvium. Areas are elongated in shape and are 200 to 1,500 acres in size. The native vegetation is mainly grasses and shrubs. Elevation is 3,700 to 3,800 feet. The average annual precipitation is about 12 inches, the average annual air temperature is about 60 degrees F, and the average frost-free period is 200 to 210 days.

Typically, the surface layer is brown loamy sand about 20 inches thick. The upper 11 inches of the substratum is light reddish brown gravelly loamy sand, and the lower part to a depth of 60 inches or more is stratified, light reddish brown sand, light reddish brown gravelly sand, and pink sand.

Included in this unit are small areas of Bluepoint soils on coppice dunes and Hollomex soils that are mainly along drainageways but are scattered throughout the unit. Also included are small areas of Dona Ana and Pajarito soils that are scattered throughout the unit. Included areas make up about 35 percent of the total acreage.

Permeability of the Yturbide soil is rapid. Available water capacity is very low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

This unit is used for livestock grazing and wildlife habitat.

The potential plant community on this unit is mainly black grama, bush muhly, blue grama, and creosotebush. The present vegetation in most areas is mainly poverty threawn, slim tridens, sand dropseed, and catclaw mimosa. The unit supports important forage plants such as fourwing saltbush and Mormon-tea. Littleleaf sumac is scattered throughout the plant community. Broom snakeweed readily invades as the plant community deteriorates. Further deterioration results in the total domination of the plant community by creosotebush and catclaw mimosa, with very little production of grass.

Rangeland seeding is not suitable because of the low precipitation. Mechanical treatment is not practical because of the steepness of slope. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce forage. This unit has limited suitability for livestock watering ponds and other water impoundments because of the seepage potential.

The average annual production of air-dry vegetation on this unit ranges from 800 pounds per acre in favorable years to 300 pounds in unfavorable years.

Prime Farmland

Prime farmland, as defined by the United States Department of Agriculture, is the land that is best suited to producing food, feed, forage, fiber, and oilseed crops. It must either be used for producing food or fiber or be available for these uses. It has the soil quality, length of growing season, and moisture supply needed to economically produce a sustained high yield of crops when it is managed properly. Prime farmland produces the highest yields with minimal energy and economic resources, and farming it results in the least disturbance of the environment.

Prime farmland commonly has an adequate and dependable supply of moisture from precipitation or irrigation. It also has a favorable temperature and length of growing season, an acceptable salt and sodium content, and an acceptable level of acidity or alkalinity. It has few, if any, rock fragments and is permeable to water and air. Prime farmland is not excessively eroded or saturated with water for long periods and is not

flooded frequently during the growing season. Soils that are limited by a hazard of flooding may qualify for prime farmland if this limitation is overcome. Onsite investigation is needed to determine the extent of this limitation.

In this survey area, an adequate and dependable supply of irrigation water of suitable quality is necessary to meet the requirements for prime farmland. About 9,500 acres, or about 0.5 percent, of the survey area is irrigated. Irrigated areas are along Highway 285, north of Roswell, and along the Pecos River, northeast of Roswell. The major crops grown are cotton, grain sorghum, and alfalfa hay. The following map units meet

the soil requirements for prime farmland when irrigated. This list does not constitute a recommendation for a particular land use.

- AaA Alama silt loam, 0 to 1 percent slopes
- AaB Alama silt loam, 1 to 3 percent slopes
- GbA Glendale silt loam
- HaA Harkey very fine sandy loam
- ReA Reakor silt loam, 0 to 1 percent slopes
- ReB Reakor silt loam, 1 to 3 percent slopes
- RgB Reakor Variant loam
- RmA Reeves loam, 0 to 1 percent slopes
- RmB Reeves loam, 1 to 3 percent slopes

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid 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 behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation 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

By Ernest Gonzales, conservation agronomist, Soil Conservation Service.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

The main crops grown in the survey area are alfalfa, cotton, and grain sorghum. Some irrigated pasture and small grain crops are also grown.

The major objectives in cropland management are to achieve proper irrigation water management, maintain soil tilth and fertility, and control soil blowing. Irrigation water management consists of controlling the rate, amount, and timing of irrigation water applications in a planned and efficient manner. To achieve proper irrigation water management, it is desirable to have a conservation irrigation system designed according to the characteristics of the soil and the crops to be grown. This is essential whether a surface system or a sprinkler system is used. Timely applications of the proper amounts of irrigation water without overirrigating are essential to obtain high yields and to conserve water. Overirrigation leaches plant nutrients out of the root zone and may reduce yields. If sprinkler irrigation is used, it is advisable that one irrigation per year be a heavy application to leach harmful salts from the root zone. This is desirable because of the tendency to underirrigate with sprinklers. Where needed, conservation practices such as irrigation pipelines, land leveling, or ditch lining should be installed to conserve water, improve efficiency, minimize erosion, and increase productivity.

Several management practices designed to maintain soil tilth and fertility and to control soil and water erosion are applicable to all of the irrigated soils in the survey area. These include practices such as conservation cropping systems, crop residue management, cover and green manure crops, and proper fertilization according to the needs of the crop and the desired level of production.

A conservation cropping system is a sequence of crops in which soil improving crops such as alfalfa and grasses balance soil depleting crops such as cotton and vegetables. A good cropping system tailored to the individual soil can help maintain good yields, tilth, and fertility. It also helps control weeds, insects, and disease and reduces erosion. Some of the factors to consider in

selecting cropping systems are the kind of soil; kind and sequence of crops; tillage methods; use of crop residue, manure, and fertilizer; insect and disease control; market demand; and the availability, management, and quality of irrigation water.

Crop residue management is leaving the crop residue on or near the surface to help control erosion, improve the water intake rate, reduce evaporation of soil moisture, maintain the content of organic matter and plant nutrients, and preserve soil structure. Protection from soil blowing is especially needed in spring, when the hazard of soil blowing is most severe. Soil blowing can be reduced by leaving residue on the soil throughout winter, plowing fields early in spring, incorporating the crop residue, leaving the soil in a rough and cloddy condition, and delaying final seedbed preparation until immediately prior to planting. The amount of residue needed to protect the soil varies according to the texture of the surface layer. Soils having a surface layer that is high in content of sand, such as Harkey very fine sandy loam, require more crop residue than soils that have a finer textured surface layer.

Cover and green manure crops are close growing grasses, legumes, or small grain and can be grown primarily for seasonal protection and soil improvement. The purpose is to control erosion during periods when the major crops do not furnish adequate cover, to add organic material to the soil, and to improve infiltration, aeration, and tilth.

In recent years, the quality of irrigation water in the Pecos Valley generally has deteriorated. It is evident that salts gradually are encroaching from north of Roswell and generally are moving south in the underground water basin. As a result of this, irrigation wells throughout the Roswell area have been metered and limitations have been placed on pumping. Many farmers now using surface irrigation are converting to sprinkler irrigation because it offers higher irrigation efficiency. Some crops, however, are not adapted to this type of irrigation because the irrigation water commonly has high salt content and high chloride content. Depending on the quality of the water used in sprinkler irrigation, careful selection of crops and additional restrictions and recommendations for irrigation have become necessary. While water of poor quality can also be a problem with surface irrigation of some crops, it is not considered to be so critical as with sprinkler irrigation. It is, however, an important consideration. In general, under sprinkler irrigation, the salinity and the content of bicarbonates and chlorides are major considerations when planning the cropping system and the timing of water applications.

It should be emphasized that sprinkling with water of poor quality should be avoided during periods of high temperatures, low humidity, and high winds. The problems resulting from the use of water of poor quality vary in kind and degree, but the most common ones in the survey area are salinity and toxicity. This is

particularly true of sprinkler irrigation, because the tendency to underirrigate when using this method is greater than when using surface irrigation, thus causing salts to accumulate in the root zone. In addition, sprinkler irrigation may cause increased toxicity to plants because it brings water with a high chloride content directly into contact with the leaves. This causes leaf burn and, in some instances, is accompanied by abnormally early leaf drop or even defoliation. In general, the order of decreasing tolerance to poor quality water is as follows: salt tolerant grasses, small grain, alfalfa, corn and sorghums, cotton, and vegetable crops.

The major objectives in pasture management are to improve soil tilth, reduce water loss and erosion, and improve the quality and quantity of the forage produced. Although only a small percentage of the acreage in the survey area is planted to permanent pasture, it is important to note that the success of a pasture program is almost entirely dependent on proper management, in addition to the proper selection of adapted species.

Seedbed preparation is extremely important in the establishment of permanent pasture, and proper techniques should be used. Planting and management will vary, depending on the species planted and on whether it is a cool- or warm-season grass. Management factors include fertilization, proper irrigation practices, proper grazing use, weed control, and other general concerns. Grazing should be controlled so that enough residue or growing crop, or both, remains throughout the year to control water erosion and soil blowing. Grazing should be managed so that plants are not grazed closer than the recommended height for each species. This will provide maximum yields when other sound management is followed and will promote pasture stand longevity. Among the other suitable management practices are to avoid grazing when the soil is wet, to fertilize according to soil tests, to take immediate action to control insect populations or disease, and to mow or spray as necessary to control weeds or other undesirable plants.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 3. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 3 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

Rangeland

By Patrick L. Shaver, range conservationist, Soil Conservation Service.

Rangeland is land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. In areas that have similar climate and topography, the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on knowledge about the relationship among the soils, vegetation, and water.

The relationship between mapped soils and vegetation was studied during this survey. It is expressed in the section "Detailed Soil Map Units" in terms of the potential natural plant community for component soils. In the following paragraphs, the potential natural plant community is defined as well as some of the other terms used in the map unit descriptions.

A potential natural plant community is an association of plants that are best adapted to a unique combination of environmental factors. Even on the same soil, these plants vary naturally in their proportions or production from place to place or from year to year. The dominant plant or plants are used to characterize the plant community because of their relative stability where abnormal disturbance or physical site deterioration has not occurred. The grasses, forbs, and shrubs that characterize the potential natural plant community on each major soil are listed by common name in the map units.

Once the plant community has been characterized for each soil, similar plant communities are grouped into range sites. A range site is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from other natural plant communities in kind, amount, or proportion of range plants. Soil properties that have the greatest influence on the productivity of range plants are those that affect the availability of moisture and plant nutrients. Other soil properties, such as soil reaction, salt content, and the presence or absence of a high water table during any period of the year, are also important factors in differentiating range sites. Range site descriptions can be used to identify the proportions of the total annual

production of each plant. Information on the range sites in this survey area is available in the local office of the Soil Conservation Service.

The average annual production is also discussed in the detailed map unit descriptions. This is the amount of air-dry 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. The total production that can be used for forage depends upon the kind of grazing animals, the season of use, and other uses that might be made of the resource in addition to grazing. The average annual production 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 and unfavorable years. In a favorable year, the amount and distribution of precipitation received during times of favorable soil and air 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.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community in a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is, in this respect, an ecological rating only. It is not in itself a direct "value" rating for any specific use.

An objective in range management may be to manage grazing so that the plants growing on a site are about the same in kind and amount as those in the potential natural plant community for that site. Such management generally results in the optimum production of forage, conservation of water, and control of erosion. In some situations, however, a range condition somewhat below potential will promote adequate conservation of soil and water while at the same time producing benefits that contribute to the objective of the landowner or landuser.

More than 99 percent of the survey area is rangeland that supports grasses, forbs, and shrubs suitable for grazing. Yearlong cow and calf operations are the dominant ranch enterprise, but many cattle and sheep ranches and yearling operations are in the area. The livestock produced on these ranches provide the principal agricultural income in the area.

Management of grazing to increase ground cover, accumulate litter, and improve the vigor and reproduction of the more productive grasses and shrubs is highly desirable. Continuous yearlong grazing or grazing the same pasture during the growing season every year results in the deterioration of the plant community,

reducing its value for livestock grazing, watershed, wildlife habitat, and erosion control.

A proper degree of grazing use combined with deferred grazing or a planned grazing system that varies the season of grazing in pastures during successive years is needed to maintain a healthy, balanced plant community. This will also provide high quality forage throughout the year. Periodic rest during different seasons of the year benefits different plants. Rest in summer encourages the production and reproduction of warm-season grasses such as sideoats grama, black grama, tobosa, galleta, plains bristlegrass, and blue grama. Rest in spring or fall, or both, is beneficial to the cool-season grasses such as western wheatgrass, New Mexico feathergrass, and bottlebrush squirreltail. Rest in fall and winter benefits shrubs such as fourwing saltbush and winterfat.

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

Recreation

The soils of the survey area are rated in table 4 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 sewerlines. 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 recreation use by the duration and intensity of flooding

and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 4, 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 by a combination of these measures.

The information in table 4 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 7 and interpretations for dwellings without basements and for local roads and streets in table 6.

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, horseback riding, and bicycling 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

By William J. Stone, biologist, Soil Conservation Service.

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.

In table 5, 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 flood hazard. 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, flood hazard, 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 plants that provide food and cover for wildlife. 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 flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, beggarweed, wheatgrass, globemallow, bladderpod, and wild buckwheat.

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. An example of a coniferous plant is juniper.

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 littleleaf sumac, shinney oak, fourwing saltbush, and catclaw.

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 saltgrass, 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. The wildlife attracted to these areas include scaled quail, meadowlark, field sparrow, cottontail, and swift 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, shore birds, raccoon, mink, and beaver.

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

Engineering

By William L. Van Pelt, engineer, Soil Conservation Service.

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. The ratings are given in the following tables: 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 need to 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 to 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 kind 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 (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) 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 6 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 the 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, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 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 7 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 7 also shows the suitability of the soils for use as daily cover for landfills. 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 effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

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

Table 7 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 due to rapid permeability of 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 needs to be considered.

The ratings in table 7 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 type 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 type 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 soil blowing.

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 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 8 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 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, 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 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 the depth to the water table is 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. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 8, 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 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 9 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a

depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce 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 or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

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 characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, 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 10 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area (9). 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 "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 a soil contains particles coarser than sand, 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 (2) and the system

adopted by the American Association of State Highway and Transportation Officials (1,4).

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, SP-SM.

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

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

Rock fragments larger than 3 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 oven-dry 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 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 11 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, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

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, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

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 change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

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 0.05 to 0.69. 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 and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or cobbly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 11, the estimated content of organic matter of the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of 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 12 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped

according to the intake of water when the soils 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 permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

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

Table 12 gives the frequency of flooding. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs, on the average, no more than once in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years.

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 absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as 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.

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

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey

soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (11). 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. In table 13, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten 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 Aridisol.

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 Orthid (*Orth*, meaning true, plus *id*, from Aridisol).

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; 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 Calciorthids (*Calci*, meaning lime, plus *orthid*, the suborder of the Aridisols that have a horizon of lime accumulation).

SUBGROUP. Each great group has a typical subgroup. Other subgroups are intergrades or extragrades. The typical 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 known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Ustollic* identifies the subgroup that has more organic carbon. An example is Ustollic Calciorthids.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where

there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, thermic Ustollic Calciorthids.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (10). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (11). Unless otherwise stated, 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."

Alama Series

The soils in the Alama series are classified as Ustollic Camborhids, fine-silty, mixed, thermic. These deep, well drained, moderately slowly permeable soils are on alluvial side slopes, fans, and terraces. The soils formed in calcareous alluvium. Slope is 0 to 5 percent. Elevation is 3,600 to 4,500 feet. The average annual precipitation is 11 to 14 inches. The average annual air temperature is about 59 to 61 degrees F, and the frost-free season is 200 to 210 days.

Typical pedon of an Alama loam in an area of Alama-Poquita association, nearly level; 1,300 feet east and

1,300 feet north of the southwest corner of sec. 25, T. 6 S., R. 24 E.

- A1—0 to 6 inches; strong brown (7.5YR 4/6) loam, dark brown (7.5YR 3/4) moist; weak fine granular structure; soft, friable, slightly sticky and slightly plastic; many very fine and fine roots and common medium roots; strongly effervescent; moderately alkaline; clear wavy boundary.
- B21—6 to 21 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots and common medium roots; few very fine and fine pores; strongly effervescent; moderately alkaline; clear wavy boundary.
- B22ca—21 to 33 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine, fine, and medium roots; common very fine and fine pores; few fine soft masses of calcium carbonate; strongly effervescent; moderately alkaline; abrupt wavy boundary.
- C1ca—33 to 60 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/8) moist; massive; hard, firm, slightly sticky and plastic; few medium roots; many very fine and fine pores; few fine soft masses of calcium carbonate; strongly calcareous; moderately alkaline.

The solum ranges from 20 to 40 inches in thickness. The control section is less than 15 percent sand that is fine or coarser.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 4 to 6. It is fine sandy loam, loam, or silt loam.

The B2 horizon has hue of 2.5YR, 5YR, or 7.5YR, value of 4 to 6 when dry and 3 to 6 when moist, and chroma of 4 to 6. It is clay loam, silt loam, or silty clay loam.

The C horizon has hue of 2.5YR, 5YR, or 7.5YR, value of 4 to 7 when dry and 3 to 6 when moist, and chroma of 4 to 8. It is loam, silt loam, clay loam, or silty clay loam.

Asparas Series

The soils in the Asparas series are classified as Aridic Argiustolls, fine-loamy, mixed, mesic. These deep, well drained, moderately slowly permeable soils are in valleys and depressional areas and on alluvial side slopes. The soils formed in alluvium derived mainly from limestone. Slope is 0 to 2 percent. Elevation is 4,300 to 4,600 feet. The average annual precipitation is 14 to 15 inches. The average annual air temperature is 54 to 56 degrees F, and the frost-free season is 180 to 190 days.

Typical pedon of an Asparas loam in an area of Threadgill-Asparas association, gently sloping; 378 feet west and 950 feet south of the northeast corner of the NW1/4SW1/4 of sec. 20, T. 5 S., R. 20 E.

- A1—0 to 4 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and very fine roots and common medium roots; slightly effervescent; moderately alkaline; abrupt smooth boundary.
- B21t—4 to 16 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; moderate coarse subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many thick clay films on faces of peds and lining interstitial pores; slightly effervescent; moderately alkaline; clear smooth boundary.
- B22t—16 to 24 inches; brown (10YR 4/3) clay loam, dark yellowish brown (10YR 3/4) moist; moderate coarse subangular blocky structure; slightly hard, friable, sticky and plastic; many very fine roots and common fine roots; few fine soft masses of calcium carbonate; many moderately thick clay films on faces of peds and lining interstitial pores; strongly effervescent; moderately alkaline; clear smooth boundary.
- B23t—24 to 38 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; common very fine and fine roots; common fine and medium soft masses of calcium carbonate; common moderately thick clay films on faces of peds and lining interstitial pores; violently effervescent; moderately alkaline; clear wavy boundary.
- Cca—38 to 60 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 4/4) moist; massive; slightly hard, friable, sticky and plastic; few very fine and fine roots; common medium soft masses of calcium carbonate and disseminated calcium carbonate; violently effervescent; moderately alkaline.

The mollic epipedon is 10 to 20 inches thick. The solum is 25 to 40 inches thick. Depth to bedrock is more than 60 inches.

The A horizon has hue of 10YR, value of 3 or 4 when dry and 2 or 3 when moist, and chroma of 2 or 3.

The B2t horizon has hue of 7.5YR or 10YR, value of 3 to 5 when dry and 2 to 4 when moist, and chroma of 2 to 4. It is loam or clay loam.

The Cca horizon has hue of 7.5YR, and it has value of 5 or 6 when dry and 4 or 5 when moist.

Bascal Series

The soils in the Bascal series are classified as Ustochreptic Calciorthids, loamy-skeletal, carbonatic, thermic. These deep, well drained, moderately permeable soils are on ridges of alluvial terraces. The soils formed in calcareous alluvium. Slope is 2 to 12 percent. Elevation is 3,600 to 4,000 feet. The average annual precipitation is 11 to 12 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 200 to 210 days.

Typical pedon of a Bascal gravelly sandy loam in an area of Bascal-Sotim association, moderately undulating; 0.5 mile north of cattle guard and 195 feet west of road in the NW1/4SW1/4 of sec. 31, T. 6 S., R. 26 E.

- A11—0 to 2 inches; light brown (7.5YR 6/4) gravelly sandy loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; few very fine pores; 25 percent pebbles coated with calcium carbonate; strongly effervescent; moderately alkaline; abrupt smooth boundary.
- A12—2 to 7 inches; light brown (7.5YR 6/4) gravelly sandy loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; few very fine pores; 25 percent pebbles coated with calcium carbonate; common fine filaments of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.
- C1ca—7 to 18 inches; pink (7.5YR 7/4) very gravelly sandy clay loam, light brown (7.5YR 6/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; common very fine pores; 40 percent coarse fragments thickly coated with calcium carbonate; disseminated calcium carbonate; violently effervescent; moderately alkaline; clear wavy boundary.
- C2ca—18 to 36 inches; pink (7.5YR 8/4) very gravelly sandy clay loam, pink (7.5YR 7/4) moist; massive; slightly hard, very friable, sticky and plastic; few very fine roots; common very fine pores; 35 percent coarse fragments thickly coated with calcium carbonate; many large soft masses of calcium carbonate and disseminated calcium carbonate; violently effervescent; moderately alkaline; clear wavy boundary.
- C3ca—36 to 60 inches; reddish yellow (7.5YR 8/6) very gravelly coarse sandy loam, reddish yellow (7.5YR 7/6) moist; single grain; loose; many irregular pores; 35 percent coarse fragments thickly coated with calcium carbonate; disseminated calcium carbonate; violently effervescent; moderately alkaline.

Depth to the calcic horizon ranges from 6 to 20 inches. The control section is 40 to 60 percent calcium carbonate. It is 35 to 50 percent coarse fragments.

The A horizon has hue of 10YR or 7.5YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 4 to 6. It is gravelly sandy loam or gravelly loam and is 15 to 25 percent coarse fragments.

The C1ca horizon has hue of 5YR or 7.5YR, value of 6 to 8 when dry and 5 to 7 when moist, and chroma of 2 to 6. It is very gravelly sandy clay loam or very gravelly loam and is 35 to 50 percent coarse fragments. The C2ca and C3ca horizons have hue of 5YR or 7.5YR, value of 6 to 8 when dry and 5 to 7 when moist, and chroma of 4 to 6. They are very gravelly fine sandy loam, very gravelly loam, very gravelly sandy clay loam, or very gravelly clay loam and are 35 to 50 percent coarse fragments.

Bascom Series

The soils in the Bascom series are classified as Ustollic Calciorthids, loamy-skeletal, carbonatic, thermic. These deep, well drained, moderately permeable soils are on ridges of alluvial terraces. The soils formed in calcareous alluvium. Slope is 2 to 7 percent. Elevation is 3,750 to 3,800 feet. The average annual precipitation is 13 to 14 inches. The average annual air temperature is about 59 to 61 degrees F, and the frost-free season is 200 to 210 days.

Typical pedon of a Bascom gravelly sandy loam in an area of Bascom-Ratliff association, moderately undulating; 1,000 feet west and 800 feet south of the northeast corner of sec. 7, T. 6 S., R. 25 E.

- A11—0 to 4 inches; brown (7.5YR 5/4) gravelly sandy loam, dark brown (7.5YR 4/4) moist; weak fine granular structure; soft, very friable, slightly plastic; many fine and very fine roots; 20 percent pebbles; disseminated calcium carbonate; very strongly effervescent; moderately alkaline; clear smooth boundary.
- A12—4 to 12 inches; brown (7.5YR 5/4) gravelly loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; common fine tubular pores; 30 percent pebbles; disseminated calcium carbonate; very strongly effervescent; moderately alkaline; abrupt smooth boundary.
- C1ca—12 to 22 inches; pink (7.5YR 7/4) extremely gravelly sandy clay loam, brown (7.5YR 5/4) moist; massive; hard, firm, sticky and plastic; common fine roots; common fine tubular pores; 80 percent hard lime pebbles; disseminated calcium carbonate; very strongly effervescent; strongly alkaline; abrupt wavy boundary.

- C2ca—22 to 26 inches; pink (7.5YR 7/4) extremely gravelly loam, brown (7.5YR 5/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common fine tubular pores; 60 percent lime coated pebbles; disseminated calcium carbonate; very strongly effervescent; strongly alkaline; abrupt wavy boundary.
- C3ca—26 to 36 inches; light brown (7.5YR 6/4) very gravelly sandy clay loam, brown (7.5YR 5/4) moist; massive; slightly hard, friable, slightly sticky and plastic; common fine roots; common fine tubular pores; 50 percent pebbles; pebbles are partially coated with calcium carbonate; disseminated calcium carbonate; very strongly effervescent; strongly alkaline; clear wavy boundary.
- C4ca—36 to 60 inches; pink (7.5YR 7/4) extremely gravelly fine sandy loam, brown (7.5YR 5/4) moist; massive; soft, very friable; few fine roots; 60 percent pebbles; pebbles are partially coated with calcium carbonate; disseminated calcium carbonate; very strongly effervescent; strongly alkaline.

Depth to the calcic horizon ranges from 12 to 15 inches. The control section is 40 to 60 percent calcium carbonate. The weighted percentage of coarse fragments in the control section ranges from 35 to 75. Texture of the fine material is fine sandy loam or sandy clay loam.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 3 or 4 when moist, and chroma of 3 or 4.

The C horizon has hue of 7.5YR or 10YR, and it has value of 6 or 7 when dry and 5 or 6 when moist. It is extremely gravelly sandy clay loam, extremely gravelly loam, very gravelly sandy clay loam, very gravelly loam, or extremely gravelly fine sandy loam.

Berino Series

The soils in the Berino series are classified as Typic Haplargids, fine-loamy, mixed, thermic. These deep, well drained, moderately permeable soils are in interdunal and depressional areas on high terraces. The soils formed in alluvial and eolian deposits. Slope is 0 to 2 percent. Elevation is 3,600 to 3,800 feet. The average annual precipitation is 11 to 12 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 200 to 210 days.

Typical pedon of Berino loamy fine sand, 0 to 2 percent slopes; 200 feet west and 800 feet south of the northeast corner of sec. 3, T. 10 S., R. 27 E.

- A11—0 to 4 inches; reddish brown (5YR 4/3) loamy fine sand, dark reddish brown (5YR 3/3) moist; single grain; loose; common fine and medium roots; moderately alkaline; clear wavy boundary.

- A12—4 to 13 inches; reddish brown (5YR 4/4) loamy fine sand, dark reddish brown (5YR 3/4) moist; weak medium subangular blocky structure; soft, very friable; common fine and medium roots; moderately alkaline; abrupt smooth boundary.
- B21t—13 to 28 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular structure; hard, firm, slightly sticky and plastic; common fine and medium roots; common fine and medium tubular pores; common thin patchy clay films on faces of peds and in pores; moderately alkaline; clear wavy boundary.
- B22tca—28 to 40 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; hard, firm, slightly sticky and plastic; common fine and medium roots; common fine and medium tubular pores; common thin clay films on faces of peds and in pores; common fine filaments of calcium carbonate; strongly effervescent; moderately alkaline; abrupt smooth boundary.
- Cca—40 to 60 inches; pinkish white (5YR 8/2) sandy clay loam, pink (5YR 7/4) moist; massive; very hard, firm, slightly sticky and plastic; few medium tubular pores; disseminated calcium carbonate; very strongly effervescent; strongly alkaline.

The solum ranges from 34 to 42 inches in thickness. Depth to the upper boundary of the calcic horizon ranges from 20 to 30 inches. The control section is 20 to 30 percent clay. It is less than 15 percent coarse fragments.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 or 4. It is loamy fine sand or fine sandy loam.

The B2t horizon has hue of 2.5YR or 5YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 4 to 6. The B2tca horizon has hue of 2.5YR or 5YR, value of 5 or 6 when dry and 3 or 4 when moist, and chroma of 4 to 6.

The Cca horizon has hue of 5YR, value of 5 to 8 when dry or moist, and chroma of 2 to 6.

Bigetty Series

The soils in the Bigetty series are classified as Cumulic Haplustolls, fine-silty, mixed, thermic. These deep, well drained, moderately slowly permeable soils are on bottom lands and in depressional areas. The soils formed in alluvium. Slope is 0 to 1 percent. Elevation is 3,600 to 4,200 feet. The average annual precipitation is 11 to 12 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 200 to 210 days.

Typical pedon of a Bigetty silt loam in an area of Reakor-Bigetty association, moderately undulating; 1,120

feet south and 264 feet east of the northwest corner of the NW1/4SE1/4 of sec. 15, T. 10 S., R. 21 E.

- A1—0 to 4 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.
- B21—4 to 16 inches; brown (10YR 5/3) silt loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine, fine, and medium roots; common very fine and fine pores and few medium pores; slightly effervescent; moderately alkaline; gradual smooth boundary.
- B22—16 to 38 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to moderate coarse subangular blocky; hard, friable, slightly sticky and slightly plastic; few very fine and fine roots and common medium roots; few very fine, fine, and medium pores; slightly effervescent; moderately alkaline; gradual smooth boundary.
- C1—38 to 60 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; massive; hard, friable, sticky and plastic; few very fine roots; common very fine pores; strongly effervescent; moderately alkaline.

Thickness of the solum ranges from 25 to 50 inches. The control section is less than 15 percent sand that is fine or coarser. The mollic epipedon is more than 20 inches thick.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 2 or 3.

The B horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 2 or 3. It is silt loam, clay loam, or silty clay loam.

The C horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 2 to 4. It is silt loam, silty clay loam, or loam. Strata of coarser texture are below a depth of 40 inches in some pedons.

Blakeney Series

The soils in the Blakeney series are classified as Ustochreptic Paleorthids, loamy, mixed, thermic, shallow. These shallow, well drained, moderately rapidly permeable soils are on ridges of high terraces and uplands. The soils formed in calcareous eolian and alluvial deposits. Slope is 0 to 5 percent. Elevation is 3,800 to 4,400 feet. The average annual precipitation is 13 to 14 inches. The average annual air temperature is

58 to 61 degrees F, and the frost-free season is 195 to 205 days.

Typical pedon of a Blakeney fine sandy loam in an area of Blakeney-Ratliff association, moderately undulating; about 1.4 miles west of headquarters and 0.55 mile north of crossroads, in the NE1/4NE1/4 of sec. 16, T. 7 S., R. 27 E.

- A11—0 to 2 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 3/4) moist; weak medium and coarse granular structure; soft, very friable, slightly sticky and slightly plastic; few fine roots; few fine pores; moderately alkaline; clear wavy boundary.
- B21—2 to 6 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 3/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots; many fine pores; slightly effervescent; moderately alkaline; clear smooth boundary.
- B22—6 to 13 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 3/4) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many fine pores; strongly effervescent; moderately alkaline; abrupt wavy boundary.
- Ccam—13 to 20 inches; pinkish white (7.5YR 8/2) continuous indurated caliche.

Depth to the petrocalcic horizon ranges from 8 to 20 inches. The profile is 5 to 20 percent gravel and cobbles.

The A horizon has hue of 7.5YR or 10YR, value of 3 or 4 when moist, and chroma of 3 or 4. It is fine sandy loam or cobbly sandy loam.

The B horizon has hue of 7.5YR or 10YR, value of 5 to 6 when dry and 3 or 4 when moist, and chroma of 4. It is fine sandy loam or cobbly sandy loam.

The Ccam horizon is indurated to strongly cemented and becomes less cemented with depth.

Bluepoint Series

The soils in the Bluepoint series are classified as Typic Torripsamments, mixed, thermic. These deep, somewhat excessively drained, rapidly permeable soils are on coppice dunes on high terraces and alluvial side slopes below landscape breaks. The soils formed in calcareous eolian deposits. Slope is 2 to 5 percent. Elevation is 3,600 to 3,800 feet. The average annual precipitation is 11 to 12 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 200 to 210 days.

Typical pedon of a Bluepoint loamy fine sand in an area of Pajarito-Bluepoint complex, hummocky; 2,000 feet north and 2,500 feet west of the southeast corner of sec. 36, T. 8 S., R. 26 E.

A11—0 to 7 inches; reddish brown (5YR 5/4) loamy fine sand, reddish brown (5YR 4/4) moist; weak fine granular structure; soft, very friable; many very fine and fine roots and few medium roots; disseminated calcium carbonate; slightly effervescent; moderately alkaline; clear smooth boundary.

A12—7 to 20 inches; yellowish red (5YR 4/6) loamy fine sand, yellowish red (5YR 3/6) moist; weak fine granular structure; soft, very friable; many very fine and fine roots and few medium and coarse roots; disseminated calcium carbonate; slightly effervescent; moderately alkaline; clear smooth boundary.

C1—20 to 50 inches; yellowish red (5YR 4/6) loamy fine sand, dark reddish brown (5YR 3/4) moist; massive; soft, friable; common very fine roots and few medium and coarse roots; disseminated calcium carbonate; slightly effervescent; moderately alkaline; gradual smooth boundary.

C2—50 to 60 inches; reddish brown (5YR 4/4) loamy fine sand, dark reddish brown (5YR 3/4) moist; massive; soft, very friable; few medium roots; disseminated calcium carbonate; slightly effervescent; moderately alkaline.

The combined A and C horizons are more than 60 inches thick. The profile is slightly effervescent to strongly effervescent throughout, and the calcium carbonate equivalent is less than 15 percent. The surface layer is not present in all pedons.

The A horizon has hue of 2.5YR or 5YR, value of 4 to 6 when dry and 3 or 4 when moist, and chroma of 4 to 6.

The C horizon has hue of 2.5YR or 5YR, value of 4 to 6 when dry and 3 or 4 when moist, and chroma of 4 or 6. It is loamy fine sand or fine sand.

Canez Series

The soils in the Canez series are classified as Ustollic Haplargids, fine-loamy, mixed, thermic. These deep, well drained, moderately permeable soils are in depressional areas on high terraces. The soils formed in alluvium. Slope is 0 to 1 percent. Elevation is 3,800 to 4,500 feet. The average annual precipitation is 13 to 14 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 195 to 205 days.

Typical pedon of a Canez fine sandy loam in an area of Redona-Canez association, gently undulating; about 1 mile northeast of windmill in the NE1/4NE1/4 of sec. 8, T. 8 S., R. 27 E.

A11—0 to 2 inches; brown (7.5YR 4/4) loamy fine sand, dark brown (7.5YR 3/4) moist; moderate fine granular structure; soft, very friable; few fine roots; few very fine pores; neutral; abrupt smooth boundary.

A12—2 to 8 inches; brown (7.5YR 4/4) fine sandy loam, dark brown (7.5YR 3/4) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable; few very fine roots; few very fine pores; neutral; clear smooth boundary.

B21t—8 to 14 inches; yellowish red (5YR 4/6) sandy clay loam, dark reddish brown (5YR 3/4) moist; moderate coarse prismatic structure parting to moderate medium and coarse subangular blocky; hard, friable, slightly sticky and slightly plastic; few very fine roots; few fine pores; neutral; clear smooth boundary.

B22t—14 to 22 inches; yellowish red (5YR 4/6) sandy clay loam, dark reddish brown (5YR 3/4) moist; moderate coarse prismatic structure parting to moderate coarse subangular blocky; hard, friable, slightly sticky and slightly plastic; few fine roots; few fine pores; mildly alkaline; clear smooth boundary.

B23t—22 to 38 inches; yellowish red (5YR 5/8) sandy clay loam, yellowish red (5YR 4/8) moist; moderate coarse prismatic structure parting to moderate medium and coarse subangular blocky; hard, friable, slightly sticky and slightly plastic; few very fine roots; few fine pores; few fine filaments of calcium carbonate; slightly effervescent; mildly alkaline; gradual wavy boundary.

B24t—38 to 60 inches; red (2.5YR 4/8) sandy clay loam, dark red (2.5YR 3/6) moist; weak coarse subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few very fine roots; few fine pores; common fine filaments of calcium carbonate; slightly effervescent; mildly alkaline.

The lower part of the argillic horizon is 5 to 15 percent calcium carbonate. Thickness of the solum is 60 inches or more.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 4. It is fine sandy loam or loam.

The Bt horizon has hue of 2.5YR, 5YR, or 7YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 4, 6, or 8. It is sandy clay loam or sandy loam.

Chispa Series

The soils in the Chispa series are classified as Ustollic Calciorthids, fine-loamy, mixed, thermic. These deep, well drained, moderately permeable soils are in depressional areas on high terraces. The soils formed in calcareous alluvial and lacustrine sediment. Slope is 0 to 2 percent. Elevation is 3,800 to 4,000 feet. The average annual precipitation is 13 to 14 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 195 to 205 days.

Typical pedon of a Chispa fine sandy loam in an area of Chispa-Malstrom association, moderately undulating;

0.25 mile north of main gravel road, along powerline; in the NE1/4NW1/4 of sec. 22, T. 10 S., R. 29 E.

A11—0 to 2 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; moderate very fine platy structure; soft, very friable, slightly plastic; common very fine roots; common very fine pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

A12—2 to 5 inches; brown (7.5YR 5/4) fine sandy loam, brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly plastic; common very fine and few fine roots; common very fine pores; slightly effervescent; moderately alkaline; abrupt wavy boundary.

B21—5 to 15 inches; light brown (7.5YR 6/4) sandy clay loam, dark brown (7.5YR 5/4) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and few fine roots; common very fine pores; strongly effervescent; moderately alkaline; gradual wavy boundary.

B22ca—15 to 23 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; moderate medium subangular blocky structure; hard, very friable, very sticky and plastic; common very fine roots; common very fine pores; few fine filaments of calcium carbonate; violently effervescent; moderately alkaline; gradual wavy boundary.

B23ca—23 to 32 inches; light brownish gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; strong fine subangular blocky structure; hard, very friable, very sticky and plastic; common very fine roots; common very fine pores; many fine and medium concretions and few fine filaments of calcium carbonate; violently effervescent; moderately alkaline; gradual wavy boundary.

C1ca—32 to 53 inches; very pale brown (10YR 8/3) clay loam, pale brown (10YR 6/3) moist; massive; hard, very friable, very sticky and plastic; disseminated calcium carbonate; violently effervescent; moderately alkaline; gradual wavy boundary.

C2ca—53 to 60 inches; very pale brown (10YR 8/3) loam, pale brown (10YR 6/3) moist; massive; hard, very friable, very sticky and plastic; disseminated calcium carbonate; violently effervescent; moderately alkaline.

The solum is 30 to 40 inches thick. Depth to any horizon that is more than 15 percent calcium carbonate and more than 5 percent visible secondary calcium carbonate is 10 to 20 inches.

The A horizon has hue of 7.5YR or 10YR, value of 3 or 4 when moist, and chroma of 3 or 4.

The B2 horizon, where present, has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 3 or 4. It is sandy clay loam or fine sandy loam. The B2ca horizon has hue of 7.5YR or 10YR,

value of 6 or 7 when dry and 5 or 6 when moist, and chroma of 2 to 4. It is loam, clay loam, or sandy clay loam.

The Cca horizon has hue of 7.5YR or 10YR, value of 6 to 8 when dry and 5 to 7 when moist, and chroma of 2 or 3. It is loam, clay loam, or sandy clay loam.

Conger Series

The soils in the Conger series are classified as Ustollic Paleorthids, loamy, mixed, thermic, shallow. These shallow, well drained, moderately permeable soils are on knolls and ridges of uplands. The soils formed in calcareous alluvium. Slope is 0 to 5 percent. Elevation is 3,900 to 4,700 feet. The average annual precipitation is 13 to 14 inches. The average annual air temperature is 58 to 60 degrees F, and the frost-free season is 190 to 200 days.

Typical pedon of a Conger loam in an area of Conger-Reagan association, moderately undulating; 0.7 mile north of State Highway 48 and 0.8 mile east on north side of trail, in the NW1/4SW1/4 of sec. 18, T. 9 S., R. 22 E.

A1—0 to 3 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; weak fine subangular blocky structure parting to weak fine granular; soft, very friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine pores; 10 percent gravel and 2 percent cobbles; slightly effervescent; moderately alkaline; clear smooth boundary.

B2—3 to 12 inches; brown (10YR 5/3) cobbly silt loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine pores; 20 percent cobbles and 10 percent gravel; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Ccam—12 to 17 inches; white indurated caliche; abrupt wavy boundary.

Cca—17 to 26 inches; white weakly cemented calcium carbonate.

Depth to the petrocalcic horizon ranges from 8 to 20 inches. The control section is 5 to 35 percent gravel and cobbles.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 or 4.

The B2 horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 3 to 5 when moist, and chroma of 3 or 4. It is loam, clay loam, or cobbly silt loam. The B2ca horizon, where present, has hue of 7.5YR or 10YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 3 or 4. It is loam, clay loam, or cobbly silt loam.

The Cca horizon, where present, has hue of 7.5YR or 10YR, value of 5 to 8 when dry and 4 to 7 when moist, and chroma of 2 to 4. It is very cobbly loam, cobbly loam, or clay loam. The Ccam horizon has hue of 7.5YR or 10YR, value of 7 or 8 when dry and 6 or 7 when moist, and chroma of 1 to 4.

Darvey Series

The soils in the Darvey series are classified as Ustollic Calciorthids, fine-loamy, mixed, mesic. These deep, well drained, moderately permeable soils are on alluvial side slopes, alluvial fans, plateaus, and valley floors. The soils formed in calcareous alluvium derived from limestone. Slope is 0 to 5 percent. Elevation is 4,400 to 5,000 feet. The average annual precipitation is 14 to 15 inches. The average annual air temperature is 54 to 56 degrees F, and the frost-free season is 180 to 190 days.

Typical pedon of a Darvey loam in an area of Pastura-Darvey association, moderately undulating; about 1.7 miles west of northeast fence corner and 40 feet south of fence, in the NE1/4NW1/4 of sec. 1, T. 4 S., R. 20 E.

A1—0 to 4 inches; brown (10YR 4/3) loam, very dark grayish brown (10YR 3/2) moist; moderate thin platy structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; slightly effervescent; moderately alkaline; abrupt wavy boundary.

B21—4 to 18 inches; brown (7.5YR 4/4) loam, dark brown (7.5YR 3/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and common fine roots; few fine soft masses of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

B22ca—18 to 29 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; few fine soft masses of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

B23ca—29 to 37 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; common very fine and fine roots; common medium soft masses of calcium carbonate; violently effervescent; moderately alkaline; clear wavy boundary.

C1ca—37 to 47 inches; pink (7.5YR 7/4) clay loam, brown (7.5YR 5/4) moist; massive; slightly hard, friable, sticky and plastic; common very fine and fine roots; disseminated calcium carbonate; violently effervescent; moderately alkaline; clear wavy boundary.

C2ca—47 to 59 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; massive; slightly

hard, friable, sticky and plastic; few fine roots; disseminated calcium carbonate; violently effervescent; moderately alkaline; abrupt wavy boundary.

C3—59 to 66 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; soft, very friable, sticky and plastic; few fine roots; common fine filaments and soft masses of calcium carbonate; strongly effervescent; moderately alkaline.

Depth to the upper part of the calcic horizon is 24 to 40 inches. Above the Cca horizon, the soil is slightly effervescent to strongly effervescent.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 2 to 4.

The B horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 or 4. It is loam or clay loam. The Bca horizon has hue of 7.5YR, value of 5 or 6 when dry and 4 to 5 when moist, and chroma of 4. It is loam or clay loam.

The Cca horizon has hue of 5YR or 7.5YR, value of 5 to 8 when dry and 4 to 7 when moist, and chroma of 4. It is loam or clay loam.

Deama Series

The soils in the Deama series are classified as Lithic Calciustolls, loamy-skeletal, carbonatic, mesic. These shallow, well drained, moderately permeable soils are on ridges, knolls, and back slopes of uplands. The soils formed in residuum derived mainly from limestone. Slope is 1 to 30 percent. Elevation is 4,400 to 5,000 feet. The average annual precipitation is 14 to 15 inches. The average annual air temperature is 54 to 56 degrees F, and the frost-free season is 180 to 190 days.

Typical pedon of Deama gravelly loam in an area of Deama-Darvey-Rock outcrop association, moderately rolling; about 0.4 mile north of fence corner and 50 feet west of fence, in the NE1/4SE1/4 of sec. 18, T. 4 S., R. 21 E.

A11—0 to 5 inches; brown (10YR 4/3) gravelly loam, dark brown (10YR 3/3) moist; weak medium granular structure; soft, very friable, slightly sticky and slightly plastic; common fine roots; few fine tubular pores; 30 percent gravel coated with calcium carbonate; violently effervescent; moderately alkaline; abrupt wavy boundary.

A12ca—5 to 10 inches; brown (10YR 5/3) extremely cobbly loam, dark brown (10YR 3/3) moist; weak medium granular structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; 50 percent cobbles and 30 percent gravel; coarse fragments are coated

with calcium carbonate; violently effervescent; moderately alkaline; abrupt wavy boundary.

R—10 inches; bedded limestone covered with calcium carbonate.

Depth to limestone ranges from 7 to 20 inches. The profile is 40 to 60 percent calcium carbonate.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 2 or 3. It is gravelly loam or very gravelly loam in the upper part and very cobbly loam or extremely cobbly loam in the lower part.

The R horizon is slightly fractured to highly fractured.

Dona Ana Series

The soils in the Dona Ana series are classified as Typic Haplargids, fine-loamy, mixed, thermic. These deep, well drained, moderately permeable soils are on low terraces along the Pecos River. The soils formed in calcareous alluvium. Slope is 0 to 1 percent. Elevation is 3,650 to 3,800 feet. The average annual precipitation is 11 to 12 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 200 to 210 days.

Typical pedon of Dona Ana sandy loam; 1,584 feet west and 1,584 feet north of the southeast corner of sec. 2, T. 8 S., R. 25 E.

A1—0 to 6 inches; reddish brown (5YR 5/4) sandy loam, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots and few fine roots; many very fine pores; strongly effervescent; moderately alkaline; abrupt smooth boundary.

B21t—6 to 12 inches; light reddish brown (5YR 6/4) sandy loam, dark reddish brown (5YR 3/4) moist; moderate fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots and few fine roots; many very fine pores; few thin clay films in pores and on faces of peds; few fine filaments of calcium carbonate; strongly effervescent; moderately alkaline; clear wavy boundary.

B22t—12 to 22 inches; light reddish brown (5YR 6/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; common very fine roots and few fine roots; common very fine and fine pores; few thin clay films on faces of peds and in pores; few fine filaments of calcium carbonate; strongly effervescent; moderately alkaline; gradual irregular boundary.

B23tca—22 to 32 inches; light reddish brown (5YR 6/3) clay loam, reddish brown (5YR 5/4) moist; moderate medium subangular blocky structure; very hard, very firm, very sticky and plastic; common very fine roots;

common very fine and fine pores; few thin clay films on faces of peds and in pores; many soft masses of calcium carbonate; violently effervescent; moderately alkaline; gradual wavy boundary.

B24tca—32 to 42 inches; light reddish brown (5YR 6/4) sandy clay loam, yellowish red (5YR 5/6) moist; moderate coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; few fine pores; few moderately thick clay films on faces of peds and in pores; many soft masses of calcium carbonate; violently effervescent; moderately alkaline; gradual wavy boundary.

B3ca—42 to 52 inches; reddish yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 5/6) moist; weak fine subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few very fine roots; few fine pores; violently effervescent; moderately alkaline; gradual wavy boundary.

IIc—52 to 60 inches; reddish yellow (5YR 6/6) loamy fine sand, yellowish red (5YR 5/6) moist; massive; soft, very friable; violently effervescent; moderately alkaline.

The solum ranges from 30 to 52 inches in thickness. Depth to the calcic horizon ranges from 15 to 30 inches.

The A horizon has hue of 5YR or 7.5YR, value of 5 or 6 when dry and 3 or 4 when moist, and chroma of 3 or 4.

The Bt horizon has hue of 5YR or 7.5YR, value of 4 or 6 when dry and 3 or 5 when moist, and chroma of 4 or 6. It is sandy clay loam or loam. The Btca horizon has hue of 5YR or 7.5YR, value of 4 to 6 when dry and 3 to 5 when moist, and chroma of 4 to 6. It is sandy clay loam or clay loam. The calcium carbonate content ranges from 15 to 40 percent.

The C horizon has hue of 5YR or 7.5YR, value of 4 to 7 when dry and 3 to 6 when moist, and chroma of 4 to 6. It is sandy loam, fine sandy loam, loamy fine sand, or fine sand.

Douro Series

The soils in the Douro series are classified as Petrocalcic Ustalfic Paleargids, fine-loamy, mixed, thermic. These moderately deep, well drained, moderately permeable soils are on low ridges of high plains. The soils formed in calcareous alluvial and eolian deposits. Slope is 0 to 2 percent. Elevation is 4,400 to 4,500 feet. The average annual precipitation is 14 to 15 inches. The average annual air temperature is 58 to 60 degrees F, and the frost-free season is 185 to 195 days.

Typical pedon of a Douro loamy fine sand in an area of Faskin, moist-Douro association, gently undulating; 210 feet north and 150 feet west of the southeast corner of sec. 24, T. 6 S., R. 31 E.

- A11—0 to 5 inches; reddish brown (5YR 4/4) loamy fine sand, dark reddish brown (5YR 3/4) moist; weak fine subangular blocky structure; soft, very friable; many very fine roots; many very fine pores; neutral; abrupt smooth boundary.
- A12—5 to 11 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine pores; mildly alkaline; clear smooth boundary.
- B21t—11 to 26 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate coarse prismatic structure; slightly hard, friable, sticky and plastic; few very fine roots; many very fine pores; thin patchy clay films on faces of peds and in pores; mildly alkaline; clear smooth boundary.
- B22t—26 to 33 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderately fine subangular blocky structure; slightly hard, friable, sticky and plastic; thin patchy clay films on faces of peds; 10 percent caliche fragments; slightly effervescent; mildly alkaline; abrupt wavy boundary.
- C1cam—33 inches; white continuous indurated caliche.

Depth to the petrocalcic horizon ranges from 20 to 40 inches. The weighted average of coarse fragments in the control section is less than 10 percent.

The A horizon has hue of 7.5YR or 5YR, and it has value of 4 or 5 when dry and 3 or 4 when moist. It is loamy fine sand or fine sandy loam.

The Bt horizon has hue of 5YR or 2.5YR, value of 4 or 5 when dry, and chroma of 4 to 6. In some pedons the Bt horizon is noncalcareous in all parts:

The Ccam horizon becomes less cemented with depth.

Ector Series

The soils in the Ector series are classified as Lithic Calcicustolls, loamy-skeletal, carbonatic, thermic. These shallow, well drained, moderately permeable soils are on back slopes, low hills, and ridges of uplands. The soils formed in residuum derived mainly from limestone. Slope is 3 to 30 percent. Elevation is 3,700 to 4,700 feet. The average annual precipitation is 11 to 14 inches. The average annual air temperature is 58 to 61 degrees F, and the frost-free season is 190 to 210 days.

Typical pedon of an Ector extremely cobbly loam in an area of Ector-Rock outcrop complex, hilly; 1,250 feet north and 1,200 feet east of the southwest corner of the SW1/4NE1/4 of sec. 20, T. 8 S., R. 21 E.

- A1—0 to 11 inches; brown (10YR 4/3) extremely cobbly loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and

common medium roots; 45 percent cobbles and 20 percent gravel; strongly effervescent; moderately alkaline; abrupt irregular boundary.

- Cca—11 to 17 inches; brown (10YR 4/3) extremely cobbly loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; 80 percent cobbles and 10 percent gravel; strongly calcareous; moderately alkaline.

- R—17 inches; limestone; some indurated caliche in cracks and deposits up to one-half inch thick on the surface of the limestone; fractures are more than 4 inches apart.

Depth to limestone is 4 to 20 inches. The weighted content of rock fragments of calcium-carbonate-coated limestone or indurated caliche ranges from 40 to 75 percent.

The A horizon has hue of 10YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 2 or 3. It is extremely cobbly loam or very cobbly loam. The weighted gravel content ranges from 15 to 30 percent and the cobble content from 25 to 60 percent.

Faskin Series

The soils in the Faskin series are classified as Ustalfic Haplargids, fine-loamy, mixed, thermic. These deep, well drained, moderately permeable soils are in depressional and interdunal areas on high plains and high terraces. The soils formed in alluvial and eolian deposits. Slope is 0 to 2 percent. Elevation is 3,800 to 4,500 feet. The average annual precipitation is 13 to 15 inches. The average annual air temperature is 58 to 61 degrees F, and the frost-free season is 185 to 205 days.

Typical pedon of Faskin fine sand, 0 to 2 percent slopes; 0.8 mile east of 90-degree bend in trail and 100 feet south in the SW1/4SW1/4 of sec. 18, T. 9 S., R. 31 E.

- A11—0 to 3 inches; yellowish brown (10YR 5/4) fine sand, dark yellowish brown (10YR 3/4) moist; single grain; loose; common very fine and few coarse roots; many very fine pores; mildly alkaline; abrupt wavy boundary.
- A12—3 to 14 inches; yellowish brown (10YR 5/4) loamy fine sand, dark yellowish brown (10YR 4/4) moist; single grain; loose; common very fine and few coarse roots; many very fine pores; mildly alkaline; abrupt wavy boundary.
- B1t—14 to 17 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; moderate coarse subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; common fine roots; common very fine pores; few thin clay films on faces of peds; mildly alkaline; clear wavy boundary.

- B21t**—17 to 24 inches; brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; strong coarse prismatic structure; hard, friable, sticky and slightly plastic; common fine roots; common fine pores; many moderately thick clay films on faces of peds; mildly alkaline; clear wavy boundary.
- B22tca**—24 to 35 inches; light reddish brown (5YR 6/4) sandy clay loam, yellowish red (5YR 5/6) moist; strong coarse prismatic structure; hard, friable, sticky and plastic; common fine roots; common fine pores; many medium soft masses of calcium carbonate and disseminated calcium carbonate; common moderately thick clay films on faces of peds; strongly effervescent; strongly alkaline; clear wavy boundary.
- B23tca**—35 to 56 inches; pink (5YR 7/4) sandy clay loam, yellowish red (5YR 5/6) moist; strong coarse prismatic structure; hard, firm, sticky and plastic; few fine roots; few fine pores; disseminated calcium carbonate; common thin clay films on faces of peds; strongly effervescent; strongly alkaline; clear wavy boundary.
- Cca**—56 to 60 inches; pinkish white (5YR 8/2) loam, pink (5YR 7/3) moist; massive; slightly hard, firm, slightly sticky and slightly plastic; disseminated calcium carbonate; violently effervescent; strongly alkaline.

Depth to the argillic horizon ranges from 9 to 20 inches. Depth to secondary carbonates is 20 to 54 inches. Thickness of the solum is 40 to 60 inches.

The A horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 to 6 when dry and 4 or 5 when moist, and chroma of 3 to 6. It is fine sand, loamy fine sand, fine sandy loam, or sandy clay loam.

The Bt horizon has hue of 2.5YR, 5YR, or 7.5YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 4 to 6. It is sandy clay loam or loam. The Btca horizon has hue of 2.5YR or 5YR, value of 6 or 7 when dry and 4 or 5 when moist, and chroma of 4 to 8.

The Cca horizon has hue of 2.5YR or 5YR, value of 5 to 8 when dry or moist, and chroma of 1 to 6. It is loam or sandy clay loam.

The Faskin soils, as mapped in this survey, are recognized as taxadjuncts to the Faskin series. They differ in that the solum is 40 to 60 inches thick and secondary calcium carbonate is at a depth of 20 to 54 inches. In some units the A horizon has hue of 10YR and the B horizon includes textures of fine sandy loam and loam. Interpretations are the same as those for the soils of the Faskin series.

Gabaldon Series

The soils in the Gabaldon series are classified as Cumulic Haplustolls, fine-silty, mixed, mesic. These deep, well drained, moderately permeable soils are in drainageways below limestone ridges. The soils formed

in calcareous alluvium derived mainly from limestone. Slope is 0 to 1 percent. Elevation is 4,200 to 4,500 feet. The average annual precipitation is 14 to 15 inches. The average annual air temperature is about 54 to 56 degrees F, and the frost-free season is 180 to 190 days.

Typical pedon of a Gabaldon silty clay loam in an area of Threadgill-Gabaldon association, gently sloping; about 600 feet south and 1,900 feet west of the northeast corner of the NW1/4NE1/4 of sec. 16, T. 5 S., R. 20 E.

- A11**—0 to 4 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate thin platy structure; slightly hard, very friable, sticky and plastic; many medium and common fine roots; many fine tubular pores; strongly effervescent; mildly alkaline; abrupt smooth boundary.
- A12**—4 to 19 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate coarse subangular blocky structure parting to moderate fine granular; slightly hard, very friable, sticky and plastic; common fine and medium roots; many fine tubular pores; strongly effervescent; mildly alkaline; gradual wavy boundary.
- A13**—19 to 28 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate coarse subangular blocky structure; slightly hard, friable, sticky and plastic; common fine and medium roots; many fine tubular pores; strongly effervescent; mildly alkaline; gradual wavy boundary.
- B2**—28 to 40 inches; brown (10YR 4/3) silty clay loam, dark brown (10YR 3/3) moist; moderate coarse subangular blocky structure; hard, friable, sticky and plastic; few fine and medium roots; many fine tubular pores; strongly effervescent; mildly alkaline; clear wavy boundary.
- C1**—40 to 60 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; massive; hard, friable, sticky and plastic; few fine roots; few fine pores; strongly effervescent; mildly alkaline.

The solum is 25 to 40 inches thick.

The A horizon has hue of 10YR, value of 3 or 4 when dry and 2 or 3 when moist, and chroma of 2 or 3.

The B horizon has hue of 10YR, value of 3 to 5 when dry and 3 or 4 when moist, and chroma of 2 or 3. It is silt loam or silty clay loam.

The C horizon has hue of 7.5YR or 10YR, value of 4 to 5 when dry and 3 or 4 when moist, and chroma of 3 or 4. It is silty clay loam or silt loam.

Gallen Series

The soils in the Gallen series are classified as Ustollic Calciorthisds, loamy-skeletal, mixed, thermic. These deep, well drained, moderately rapidly permeable soils are on stream terraces. The soils formed in calcareous alluvium.

Slope is 2 to 15 percent. Elevation is 3,700 to 3,750 feet. The average annual precipitation is 13 to 14 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 195 to 205 days.

Typical pedon of Gallen very gravelly loam, 2 to 15 percent slopes; 700 feet east and 1,900 feet south of the northwest corner of sec. 24, T. 4 S., R. 25 E.

A1—0 to 4 inches; brown (7.5YR 5/4) very gravelly loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky; many fine and few medium roots; 40 percent pebbles; calcium carbonate coatings on undersides of gravel; strongly effervescent; moderately alkaline; abrupt smooth boundary.

B2ca—4 to 15 inches; reddish brown (5YR 5/3) extremely gravelly loam, reddish brown (5YR 4/3) moist; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and few medium roots; common fine tubular pores; 70 percent pebbles; calcium carbonate coatings on all sides of pebbles; strongly effervescent; moderately alkaline; clear wavy boundary.

C1ca—15 to 25 inches; light reddish brown (5YR 6/3) extremely gravelly sandy loam, reddish brown (5YR 4/4) moist; massive; soft, very friable; common fine and few medium roots; 90 percent pebbles; calcium carbonate coating on undersides of pebbles; strongly effervescent; moderately alkaline; clear wavy boundary.

IIC2—25 to 30 inches; light reddish brown (5YR 6/4) extremely gravelly sand, yellowish red (5YR 4/6) moist; massive; soft, very friable; common fine and few medium roots; 90 percent pebbles; calcium carbonate coating on underside of pebbles; sand-sized gypsum crystals; slightly effervescent; moderately alkaline; abrupt wavy boundary.

IIC3—30 to 60 inches; yellowish red (5YR 4/6) very gravelly sand, yellowish red (5YR 4/6) moist; single grain; loose; few fine roots; 50 percent pebbles; undersides of some pebbles coated with calcium carbonate; pendants of gypsum on undersides of pebbles; slightly effervescent; moderately alkaline.

The solum is 13 to 25 inches thick. The control section is 40 to 90 percent rock fragments.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 2 to 4.

The B2ca horizon has hue of 5YR or 7.5YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 or 4. It is extremely gravelly loam or very gravelly loam. Calcium carbonate content is 15 to 20 percent.

The C1ca horizon has hue of 5YR or 7.5YR, value of 6 or 7 when dry and 4 or 5 when moist, and chroma of 4. It is extremely gravelly loam, extremely gravelly sandy loam, or very gravelly sandy loam. The IIC2 and IIC3

horizons have hue of 5YR or 7.5YR, value of 6 or 7 when dry and 4 or 5 when moist, and chroma of 4 or 6.

Glendale Series

The soils in the Glendale series are classified as Typic Torrifluvents, fine-silty, mixed (calcareous), thermic.

These deep, well drained, moderately slowly permeable soils are on flood plains. The soils formed in calcareous alluvium. Slope is 0 to 1 percent. Elevation is 3,500 to 3,700 feet. The average annual precipitation is 11 to 12 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 200 to 210 days.

Typical pedon of a Glendale silt loam in an area of Glendale-Pecos-Harkey association; about 0.1 mile west of eastern edge of field and 100 feet north of road, in the SE1/4SW1/4 of sec. 20, T. 7 S., R. 26 E.

Ap—0 to 8 inches; reddish brown (5YR 5/3) silt loam, dark reddish brown (5YR 3/4) moist; moderate medium granular structure; hard, firm, sticky and plastic; common fine and medium roots; few fine filaments of salt; strongly effervescent; moderately alkaline; clear smooth boundary.

C1—8 to 16 inches; reddish brown (5YR 5/3) silt loam, dark reddish brown (5YR 3/4) moist; massive; hard, firm, sticky and plastic; common fine and medium roots; few fine filaments of salt; strongly effervescent; moderately alkaline; abrupt wavy boundary.

C2—16 to 23 inches; reddish brown (5YR 5/4) silt loam, dark reddish brown (5YR 3/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots; very few fine filaments of salt; strongly effervescent; moderately alkaline; clear wavy boundary.

C3—23 to 36 inches; brown (7.5YR 5/4) silt loam, dark brown (7.5YR 3/4) moist; massive; hard, firm, sticky and plastic; common fine and medium roots; few fine soft masses of salt; slightly effervescent; moderately alkaline; abrupt wavy boundary.

C4—36 to 44 inches; reddish brown (5YR 5/4) very fine sandy loam, dark reddish brown (5YR 3/4) moist; massive; slightly hard, friable; common fine and medium roots; slightly effervescent; moderately alkaline; abrupt wavy boundary.

C5—44 to 50 inches; reddish brown (5YR 5/3) silt loam, dark reddish brown (5YR 3/4) moist; massive; hard, firm, sticky and plastic; common fine and medium roots; few fine soft masses of salt; strongly effervescent; moderately alkaline; abrupt wavy boundary.

C6—50 to 60 inches; light reddish brown (5YR 6/4) fine sand, reddish brown (5YR 4/4) moist; massive; loose; common fine and medium roots; slightly effervescent; moderately alkaline.

The control section is dominantly silt loam or silty clay loam.

The A horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 to 6 when dry and 3 to 5 when moist, and chroma of 3 or 4.

The C horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 to 6 when dry and 3 or 4 when moist, and chroma of 3 or 4. Below a depth of 40 inches in some pedons, the C horizon is highly stratified with layers of silt loam, clay loam, silty clay loam, fine sandy loam, very fine sandy loam, loamy fine sand, and fine sand.

Harkey Series

The soils in the Harkey series are classified as Typic Torrifluvents, coarse-silty, mixed (calcareous), thermic. These deep, well drained, moderately permeable soils are on flood plains. The soils formed in calcareous alluvium. Slope is 0 to 1 percent. Elevation is 3,500 to 3,700 feet. The average annual precipitation is 11 to 12 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 200 to 210 days.

Typical pedon of a Harkey very fine sandy loam in an area of Glendale-Harkey association; in a plowed field 1 mile south of house and 50 feet east of road, in the NE1/4NE1/4 of sec. 28, T. 8 S., R. 24 E.

Ap—0 to 7 inches; brown (10YR 5/3) very fine sandy loam, dark brown (10YR 4/3) moist; hard, friable, slightly sticky; many fine and very fine roots; many fine and very fine pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

C1—7 to 28 inches; yellowish brown (10YR 5/4) very fine sandy loam, dark yellowish brown (10YR 4/4) moist; massive; hard, very friable, slightly sticky; common fine roots; many fine and very fine pores; slightly effervescent; moderately alkaline; gradual wavy boundary.

C2—28 to 60 inches; yellowish brown (10YR 5/4) loam, dark yellowish brown (10YR 4/4) moist; massive; hard, friable, slightly sticky; few coarse roots; common fine and few medium pores; strongly effervescent; moderately alkaline.

The Ap horizon has hue of 7.5YR or 10YR, value of 4 to 6 when dry and 3 to 5 when moist, and chroma of 3 or 4. It is very fine sandy loam or silt loam.

The C horizon has hue of 7.5YR or 10YR, value of 4 to 6 when dry and 3 to 5 when moist, and chroma of 3 or 4. It is silt loam, loam, or very fine sandy loam.

Hodgins Series

The soils in the Hodgins series are classified as Ustollic Camborthids, fine-silty, mixed, thermic. These deep, well drained, moderately permeable soils are on long alluvial side slopes. The soils formed in alluvium derived mainly from limestone. Slope is 0 to 3 percent.

Elevation is 4,000 to 4,300 feet. The average annual precipitation is 13 to 14 inches. The average annual air temperature is 58 to 60 degrees F, and the frost-free season is 190 to 200 days.

Typical pedon of a Hodgins silt loam in an area of Hodgins-Ranstein association, gently undulating; 2,600 feet west and 300 feet north of the southeast corner of sec. 19, T. 8 S., R. 22 E.

A1—0 to 3 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 3/3) moist; weak thin platy structure and weak fine granular; soft, very friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine tubular pores; strongly effervescent; moderately alkaline; abrupt smooth boundary.

B21—3 to 11 inches; yellowish brown (10YR 5/4) silt loam, brown (10YR 4/3) moist; weak coarse prismatic structure parting to strong subangular blocky; slightly hard, friable, sticky and plastic; common fine and very fine roots; common fine tubular pores; strongly effervescent; moderately alkaline; abrupt wavy boundary.

B22ca—11 to 23 inches; yellowish brown (10YR 5/4) light silty clay loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; few fine roots; few fine tubular pores; common fine soft masses of calcium carbonate; strongly effervescent; moderately alkaline; clear wavy boundary.

B23ca—23 to 36 inches; pale brown (10YR 6/3) light silty clay loam, brown (10YR 4/3) moist; strong coarse prismatic structure; slightly hard, friable, sticky and plastic; few fine roots; few fine tubular pores; common fine soft masses of calcium carbonate; strongly effervescent; moderately alkaline; clear wavy boundary.

B24ca—36 to 42 inches; yellowish brown (10YR 5/4) light silty clay loam, brown (10YR 4/3) moist; weak coarse prismatic structure; slightly hard, friable, sticky and plastic; few fine roots; few fine tubular pores; few fine soft masses of calcium carbonate; violently effervescent; moderately alkaline; clear smooth boundary.

C1—42 to 60 inches; yellowish brown (10YR 5/4) silty clay loam, brown (10YR 4/3) moist; massive; slightly hard, sticky and plastic; few fine roots; few fine tubular pores; strongly effervescent; mildly alkaline.

The control section has as much as 5 percent visible segregations of calcium carbonate. It is 15 to 20 percent calcium carbonate.

The A horizon has hue of 7.5YR or 10YR, value of 4 to 6 when dry and 3 or 4 when moist, and chroma of 3 or 4.

The B2 horizon has hue of 7.5YR or 10YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 3

or 4. It is silt loam or silty clay loam. It is 1 to 5 percent masses of calcium carbonate. The B2ca horizon has hue of 7.5YR or 10YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 4 to 6.

The C horizon has hue of 7.5YR or 10YR, value of 4 or 6 when dry and 4 or 5 when moist, and chroma of 4 to 6.

Hogadero Series

The soils in the Hogadero series are classified as Aridic Calciustolls, loamy-skeletal, mixed, mesic. These deep, well drained, slowly permeable soils are on ridges. The soils formed in old alluvial deposits derived mainly from igneous and sedimentary rocks. Slope is 1 to 5 percent. Elevation is 4,300 to 4,700 feet. The average annual precipitation is 14 to 15 inches. The average annual air temperature is 54 to 56 degrees F, and the frost-free season is 180 to 190 days.

Typical pedon of a Hogadero gravelly loam in an area of Hogadero-Pena association, moderately rolling; 200 feet north and 128 feet east of the southwest corner of the NW1/4SE1/4 of sec. 18, T. 5 S., R. 20 E.

- A1—0 to 10 inches; brown (10YR 4/3) gravelly loam, dark brown (10YR 3/3) moist; moderate medium granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots and few medium roots; 20 percent gravel; disseminated calcium carbonate; strongly effervescent; mildly alkaline; abrupt wavy boundary.
- C1ca—10 to 27 inches; white (10YR 8/1) very gravelly sandy loam, light gray (10YR 7/2) moist; massive; strongly cemented in the upper part and hard in the lower part, firm; few very fine, fine, and medium roots in cracks and pockets; 50 percent gravel; disseminated calcium carbonate; gravel coated with calcium carbonate; violently effervescent; moderately alkaline; clear wavy boundary.
- IIC2ca—27 to 55 inches; light brown (7.5YR 6/4) extremely gravelly loamy sand, light brown (7.5YR 6/4) moist; massive; loose; few very fine and fine roots; 60 percent gravel and 10 percent cobbles; common medium soft masses of calcium carbonate and disseminated calcium carbonate; large fragments coated on bottom and small fragments completely coated with calcium carbonate; violently effervescent; moderately alkaline; abrupt wavy boundary.
- IIC3ca—55 to 72 inches; pink (7.5YR 7/4) extremely gravelly sand, light brown (7.5YR 6/4) moist; massive; slightly hard, friable; 75 percent gravel and 5 percent cobbles; common medium soft masses of calcium carbonate and disseminated calcium carbonate; coarse fragments partially coated with calcium carbonate; violently effervescent; moderately alkaline.

The depth to the C1ca horizon ranges from 10 to 20 inches. The weighted percentage of rock fragments in the control section averages 35 to 60. The calcium carbonate content of the control section is 15 to 30 percent.

The A horizon has value of 3 or 4 when dry and 2 or 3 when moist, and it has chroma of 2 or 3. It is 15 to 25 percent gravel.

The C1ca horizon has hue of 10YR, value of 7 or 8 when dry and 6 or 7 when moist, and chroma of 1 or 2. It is very gravelly sandy loam or very gravelly loam. It has a hardness of less than 3 on the Mohs' scale. The IIC2 and IIC3 horizons have hue of 7.5YR or 10YR, value of 6 or 7 when dry and 5 or 6 when moist, and chroma of 4. They are extremely gravelly loamy sand or extremely gravelly sand.

Hollomex Series

The soils in the Hollomex series are classified as Typic Torriorthents, fine-loamy, gypsic, thermic. These deep, well drained, moderately permeable soils are on knolls and ridges and in depressional areas on terraces. The soils formed in alluvium and residuum. Slope is 0 to 3 percent. Elevation is 3,600 to 4,500 feet. The average annual precipitation is 11 to 14 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 200 to 210 days.

Typical pedon of a Hollomex loam in an area of Hollomex-Reeves-Milner, dry loams, gently undulating; 0.1 mile south of oil pad, in the NW1/4NW1/4SW1/4 of sec. 27, T. 10 S., R. 26 E.

- A11—0 to 2 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; soft, very friable; common fine roots; common very fine pores; strongly effervescent; mildly alkaline; abrupt smooth boundary.
- A12—2 to 5 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common very fine pores; few fine soft masses and filaments of calcium carbonate; violently effervescent; mildly alkaline; abrupt wavy boundary.
- C1cs—5 to 10 inches; very pale brown (10YR 8/3) gypsfiferous loam, very pale brown (10YR 7/3) moist; massive; slightly hard, friable, slightly sticky; few very fine roots; common very fine pores; common medium soft masses of calcium carbonate; strongly effervescent; neutral; clear wavy boundary.
- C2cs—10 to 60 inches; pale yellow (2.5Y 8/4) gypsfiferous loam, pale yellow (2.5Y 7/4) moist; massive; slightly hard, friable, slightly sticky; few very fine roots; common medium soft masses of calcium carbonate; strongly effervescent; neutral.

Depth to gypsiferous beds is less than 20 inches.

The A horizon has hue of 5YR, 7.5YR, or 10YR, value of 5 to 7 when dry and 4 or 5 when moist, and chroma of 3 or 4. It is 0.5 inch to 10 inches thick.

The Ccs horizon has an apparent texture of sandy loam, loamy sand, sand, loam, or silt loam and ranges widely in color.

Ima Series

The soils in the Ima series are classified as Ustochreptic Camborthids, coarse-loamy, mixed, thermic. These deep, well drained, moderately rapidly permeable soils are on alluvial side slopes, plains, and ridges and in depressional areas on uplands. The soils formed in alluvium. Slope is 0 to 3 percent. Elevation is 3,750 to 4,500 feet. The average annual precipitation is 13 to 14 inches. The average annual air temperature is 58 to 60 degrees F, and the frost-free season is 190 to 200 days.

Typical pedon of an Ima loamy fine sand in an area of Blakeney-Ima association, moderately undulating; 0.2 mile west of road junction and 50 feet south of road, in the NW1/4SW1/4 of sec. 15, T. 10 S., R. 21 E.

- A11—0 to 5 inches; dark yellowish brown (10YR 4/4) loamy fine sand, dark yellowish brown (10YR 3/4) moist; weak fine granular structure; soft, very friable; common fine roots; mildly alkaline; clear wavy boundary.
- A12—5 to 14 inches; yellowish brown (10YR 5/4) fine sandy loam, dark yellowish brown (10YR 4/4) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common fine roots; disseminated calcium carbonate; slightly effervescent; mildly alkaline; abrupt smooth boundary.
- B22ca—14 to 42 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; few fine filaments of calcium carbonate; slightly effervescent; mildly alkaline; clear wavy boundary.
- C—42 to 60 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) moist; massive; hard, friable, slightly sticky and slightly plastic; few fine roots; few fine filaments of calcium carbonate; slightly effervescent; mildly alkaline.

The solum is 24 to 46 inches thick. The control section is 0 to 15 percent rock fragments.

The A horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 or 4. It is loamy fine sand or fine sandy loam.

The B2 horizon has hue of 5YR or 7.5YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 3 or 4. It is fine sandy loam or sandy loam. Calcium carbonate content ranges from 0 to 15 percent.

The C horizon has hue of 5YR or 7.5YR, value of 5 or 6 when dry and 3 to 5 when moist, and chroma of 4 to 6.

Jalmar Series

The soils in the Jalmar series are classified as Arenic Ustalfic Haplargids, loamy, mixed, thermic. These deep, well drained, moderately permeable soils are on plains, in interdunal areas, and in depressional areas on high plains and high terraces. The soils formed in alluvial and eolian deposits. Slope is 0 to 2 percent. Elevation is 3,900 to 4,500 feet. The average annual precipitation is 13 to 15 inches. The average annual air temperature is 58 to 61 degrees F, and the frost-free season is 185 to 205 days.

Typical pedon of a Jalmar fine sand in an area of Roswell-Jalmar fine sands, hilly; 600 feet north and 300 feet west of a cattle guard, in the SE1/4NW1/4 of sec. 1, T. 10 S., R. 30 E.

- A11—0 to 6 inches; brown (7.5YR 5/4) fine sand, dark brown (7.5YR 4/4) moist; single grain; loose; common very fine roots; few fine pores; neutral; abrupt smooth boundary.
- A12—6 to 12 inches; light brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) moist; single grain; loose; common very fine roots; few fine pores; neutral; clear wavy boundary.
- A13—12 to 22 inches; reddish yellow (7.5YR 7/6) fine sand, strong brown (7.5YR 5/6) moist; single grain; loose; common very fine roots; few fine pores; neutral; clear wavy boundary.
- A3—22 to 34 inches; reddish yellow (7.5YR 7/6) fine sand, reddish yellow (7.5YR 6/6) moist; massive; soft, very friable; common very fine roots; few fine pores; neutral; abrupt wavy boundary.
- B21t—34 to 45 inches; reddish yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, firm, sticky and plastic; continuous clay films on faces of prisms; few fine and medium roots; many very fine pores; neutral; clear wavy boundary.
- B22t—45 to 60 inches; reddish yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, firm, sticky and plastic; continuous clay films on sides of prisms; few fine and medium roots; many very fine pores; neutral.

The solum is 60 to 80 inches thick. Some pedons have a calcic horizon below a depth of 60 inches.

The A horizon has hue of 5YR or 7.5YR, value of 5 to 7 when dry and 4 or 5 when moist, and chroma of 4 to 6. It is 20 to 40 inches thick.

The Bt horizon has hue of 2.5YR or 5YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 4 or 6.

Kimbrough Series

The soils in the Kimbrough series are classified as Petrocalcic Calciustolls, loamy, mixed, thermic, shallow. These shallow, well drained, moderately permeable soils are on ridges on high plains and uplands. The soils formed in calcareous alluvium. Slope is 0 to 15 percent. Elevation is 4,200 to 4,700 feet. The average annual precipitation is about 13 to 15 inches. The average annual air temperature is 58 to 60 degrees F, and the frost-free season is 185 to 200 days.

Typical pedon of a Kimbrough gravelly fine sandy loam in an area of Kimbrough-Slaughter complex, gently undulating; 100 feet west and 80 feet south of fence corner, in the SW1/4NE1/4 of sec. 26, T. 10 S., R. 31 E.

A11—0 to 7 inches; brown (10YR 5/3) gravelly fine sandy loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine pores; strongly effervescent; moderately alkaline; abrupt smooth boundary.

A12—7 to 11 inches; brown (10YR 5/3) gravelly fine sandy loam, dark brown (10YR 3/3) moist; weak medium prismatic structure; soft, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine pores; strongly effervescent; moderately alkaline; abrupt wavy boundary.

C2cam—11 to 15 inches; white (N 8/0) indurated caliche layer containing a few fractures; laminar in the upper part; becomes softer with depth.

Depth to the petrocalcic horizon ranges from 4 to 20 inches. The control section is gravelly fine sandy loam or gravelly loam and is 15 to 35 percent coarse fragments.

The A11 horizon has hue of 7.5YR or 10YR, value of 3 to 5 when dry and 2 or 3 when moist, and chroma of 2 or 3. It is gravelly fine sandy loam or gravelly loam. The A12 horizon has hue of 7.5YR or 10YR, value of 3 to 5 when dry and 2 or 3 when moist, and chroma of 2 or 3.

The Ccam horizon in some pedons is not fractured. It becomes less cemented with depth.

Latom Series

The soils in the Latom series are classified as Lithic Ustic Torriorthents, loamy, mixed (calcareous), thermic. These shallow, well drained, moderately permeable soils are on low ridges and erosional side slopes of terraces, terrace fronts, and escarpments. The soils formed in residuum derived mainly from sandstone. Slope is 3 to 15 percent. Elevation is 3,700 to 4,100 feet. The average

annual precipitation is 13 to 15 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 195 to 205 days.

Typical pedon of Latom fine sandy loam, moderately rolling; about 60 miles northeast of Roswell; 600 feet west and 900 feet north of the southeast corner of sec. 27, T. 3 S., R. 27 E.

A11—0 to 2 inches; reddish brown (5YR 5/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak fine granular structure; soft, very friable; common fine and very fine roots; strongly effervescent; moderately alkaline; clear smooth boundary.

A12—2 to 8 inches; light reddish brown (5YR 6/4) fine sandy loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, friable; common fine and very fine roots; few medium masses of carbonates; strongly effervescent; moderately alkaline; abrupt wavy boundary.

C—8 to 17 inches; pink (5YR 7/3) fine sandy loam, reddish brown (5YR 5/4) moist; moderate medium platy structure; hard, firm; few fine and very fine roots; many medium seams of carbonates; strongly effervescent; moderately alkaline; clear irregular boundary.

R—17 inches; strongly cemented sandstone.

Depth to lithic contact is 4 to 20 inches.

The A horizon has hue of 2.5YR or 5YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3, 4, or 6.

The C horizon has hue of 2.5YR or 5YR, value of 4, 5, or 7 when dry and 3 or 5 when moist, and chroma of 3 or 4. It is fine sandy loam, fine sand, or very fine sand.

Malstrom Series

The soils in the Malstrom series are classified as Ustochreptic Calciorthids, coarse-loamy, mixed, thermic. These deep, well drained, moderately rapidly permeable soils are on low ridges of high terraces. The soils formed in calcareous alluvial and eolian deposits. Slope is 0 to 4 percent. Elevation is 3,800 to 4,100 feet. The average annual precipitation is 13 to 14 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 195 to 205 days.

Typical pedon of a Malstrom loamy fine sand in an area of Chispa-Malstrom association, moderately undulating; 0.4 mile north of main gravel road, in the NE1/4NW1/4 of sec. 22, T. 10 S., R. 29 E.

A1—0 to 4 inches; reddish brown (7.5YR 5/4) loamy fine sand, brown (7.5YR 4/2) moist; single grain; loose, very friable; many fine roots; many very fine pores; mildly alkaline; clear wavy boundary.

B2—4 to 14 inches; brown (7.5YR 5/4) loamy fine sand, brown (7.5YR 4/4) moist; weak fine subangular blocky structure; soft, very friable; common very fine roots and few fine roots; common very fine pores and few fine pores; mildly alkaline; clear wavy boundary.

C1—14 to 26 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) moist; massive; soft, very friable, slightly plastic; common very fine roots and few fine roots; common very fine pores and few fine pores; few fine soft masses of calcium carbonate; violently effervescent; strongly alkaline; gradual wavy boundary.

C2ca—26 to 46 inches; pink (7.5YR 7/4) loam, light brown (7.5YR 6/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; common very fine pores; disseminated calcium carbonate; violently effervescent; strongly alkaline; clear wavy boundary.

C3ca—46 to 60 inches; pink (7.5YR 7/4) fine sandy loam, light brown (7.5YR 6/4) moist; massive; hard, firm; disseminated calcium carbonate; violently effervescent; strongly alkaline.

Depth to the calcic horizon ranges from 20 to 30 inches.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 3 or 4. It is loamy fine sand or fine sand.

The B horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 3 or 4.

The C1 horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 3 or 4.

The Cca horizon has hue of 5YR, 7.5YR, or 10YR, value of 7 or 8 when dry and 6 or 7 when moist, and chroma of 3 or 4. It is loam or fine sandy loam. It is 15 to 30 percent calcium carbonate.

Milner Series

The soils in the Milner series are classified as Calcic Gypsiorthids, fine-silty, mixed, thermic. These deep, well drained, moderately permeable soils are on alluvial side slopes and in depressional areas. The soils formed in calcareous, gypsiferous alluvium. Slope is 0 to 8 percent. Elevation is 3,550 to 4,500 feet. The average annual precipitation is 11 to 14 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 195 to 210 days.

Typical pedon of a Milner loam in an area of Hollomex, moist-Milner-Reeves, moist loams, moderately undulating; 2,300 feet south and 500 feet west of the northeast corner of sec. 9, T. 6 S., R. 24 E.

A1—0 to 3 inches; reddish brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; moderate fine

granular structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots; strongly effervescent; moderately alkaline; abrupt smooth boundary.

B21ca—3 to 9 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; strong fine subangular blocky structure; slightly hard, friable, sticky and plastic; common fine and medium roots; few fine tubular pores; disseminated calcium carbonate; strongly effervescent; moderately alkaline; clear wavy boundary.

B22ca—9 to 13 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; few medium roots; few fine tubular pores; few fine masses of gypsum crystals; disseminated calcium carbonate; strongly effervescent; moderately alkaline; abrupt wavy boundary.

C1cs—13 to 17 inches; pink (5YR 7/4) gypsiferous clay loam, red (2.5YR 5/8) moist; massive; hard, firm, slightly sticky and slightly plastic; few medium roots; few fine tubular pores; common fine masses of gypsum crystals; disseminated calcium carbonate; strongly effervescent; mildly alkaline; clear wavy boundary.

C2cs—17 to 60 inches; pink (5YR 7/4) gypsiferous clay loam, red (2.5YR 5/8) moist; massive; hard, firm, slightly sticky and slightly plastic; common fine masses of gypsum crystals; disseminated calcium carbonate; strongly effervescent; mildly alkaline.

Depth to gypsiferous sediment is 10 to 20 inches. Thickness of the solum ranges from 10 to 20 inches.

The A horizon has hue of 5YR, 7.5YR, or 10YR, value of 5 or 6 when dry and 3 or 4 when moist, and chroma of 2 to 4.

The B horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 to 6 when dry and 3 to 5 when moist, and chroma of 3 or 4. It is loam or clay loam.

The Ccs horizon has hue of 2.5YR, 7.5YR, or 10YR, value of 4 to 8 when dry and 3 to 7 when moist, and chroma of 2 to 8. It is gypsiferous loam or clay loam. The C3 horizon has hue of 2.5YR, 5YR, or 7.5YR, value of 5 to 8 when dry and 5 or 6 when moist, and chroma of 3 to 8. It is highly gypsiferous material of variable apparent textures.

Nutivoli Series

The soils in the Nutivoli series are classified as Typic Ustipsamments, mixed, thermic. These deep, excessively drained, rapidly permeable soils are on dunes of high plains. The soils formed in eolian material derived mainly from sandy sediment. Slope is 2 to 13 percent. Elevation is 4,100 to 4,500 feet. The average annual precipitation is 14 to 15 inches. The average annual air temperature

is 58 to 60 degrees F, and the frost-free season is 185 to 195 days.

Typical pedon of a Nutivoli fine sand in an area of Nutivoli-Faskin, moist fine sands, moderately rolling; 0.5 mile north and 0.1 mile west of cattle guard, in the NE1/4SE1/4 of sec. 16, T. 3 S., R. 28 E.

- A—0 to 6 inches; brown (7.5YR 5/4) fine sand, brown (7.5YR 4/4) moist; massive; soft, very friable; common fine and very fine roots and few medium roots; mildly alkaline; clear smooth boundary.
- C1—6 to 15 inches; red (2.5YR 5/6) loamy fine sand, red (2.5YR 4/6) moist; very weak coarse prismatic structure; slightly hard, very friable; common very fine, fine, and medium roots; mildly alkaline; clear smooth boundary.
- C2—15 to 40 inches; yellowish red (5YR 5/6) loamy sand, yellowish red (5YR 4/6) moist; very weak coarse prismatic structure; slightly hard, very friable; common fine and very fine roots and few medium roots; mildly alkaline.
- C3—40 to 60 inches; yellowish red (5YR 5/8) fine sand, yellowish red (5YR 4/8) moist; massive; slightly hard, friable; few fine and medium roots; mildly alkaline.

The A horizon has hue of 5YR or 7.5YR, value of 5 or 6 when dry and 4 to 6 when moist, and chroma of 4, 6, or 8.

The C horizon has hue of 2.5YR or 7.5YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 4, 6, or 8. Texture is loamy fine sand or fine sand.

Pajarito Series

The soils in the Pajarito series are classified as Typic Camborthids, coarse-loamy, mixed, thermic. These deep, well drained, moderately rapidly permeable soils are on low ridges and coppice dunes and in interdunal areas on alluvial fans and alluvial side slopes below landscape breaks. The soils formed in calcareous alluvium. Slope is 0 to 8 percent. Elevation is 3,600 to 4,000 feet. The average annual precipitation is 11 to 12 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 200 to 210 days.

Typical pedon of Pajarito loamy fine sand, 0 to 3 percent slopes; 528 feet east and 1,056 feet south of the northwest corner of sec. 2, T. 7 S., R. 27 E.

- A1—0 to 4 inches; reddish brown (5YR 4/3) loamy fine sand, dark reddish brown (5YR 3/3) moist; weak thin platy structure; soft, very friable; common very fine roots and few fine roots; disseminated calcium carbonate; slightly effervescent; moderately alkaline; abrupt smooth boundary.
- B21—4 to 16 inches; reddish brown (5YR 5/4) sandy loam, dark reddish brown (5YR 3/4) moist; weak coarse subangular blocky structure; slightly hard,

friable; common very fine and few fine roots; common fine tubular pores; 10 percent pebbles coated with calcium carbonate; few fine soft masses of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

B22ca—16 to 37 inches; reddish brown (5YR 5/4) sandy loam, dark reddish brown (5YR 3/4) moist; weak coarse subangular blocky structure; slightly hard, friable; few fine roots; few fine tubular pores; 10 percent lime fragments; common fine soft masses of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

C1—37 to 60 inches; reddish brown (5YR 5/4) sandy loam, dark reddish brown (5YR 3/4) moist; massive; slightly hard, friable; 10 percent pebbles coated with calcium carbonate; few fine soft masses of calcium carbonate; strongly effervescent; moderately alkaline.

The solum ranges from 25 inches to more than 40 inches in thickness. The control section is 5 to 15 percent calcium carbonate. It is 5 to 10 percent coarse fragments.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 or 4. It is loamy fine sand or fine sandy loam.

The B2 horizon has hue of 5YR or 7.5YR, value of 4 to 6 when dry and 3 to 5 when moist, and chroma of 4 to 6. It is loamy very fine sand, sandy loam, fine sandy loam, or loam.

The C horizon has hue of 5YR or 7.5YR, value of 4 to 6 when dry and 3 to 5 when moist, and chroma of 4 to 6. It is loamy fine sand, sandy loam, or fine sandy loam.

Pastura Series

The soils in the Pastura series are classified as Ustollic Paleorthids, loamy, mixed, mesic, shallow. These shallow, well drained, moderately permeable soils are on ridges, knolls, and foot slopes of uplands and plains. The soils formed in calcareous alluvium. Slope is 0 to 5 percent. Elevation is 4,400 to 4,900 feet. The average annual precipitation is 14 to 15 inches. The average annual air temperature is 54 to 56 degrees F, and the frost-free season is 180 to 190 days.

Typical pedon of a Pastura loam in an area of Pastura-Darvey association, moderately undulating; about 60 feet south and 50 feet east of the northwest fence corner, in the NW1/4NW1/4 of sec. 1, T. 4 S., R. 20 E.

A11—0 to 3 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; moderate thin platy structure; soft, very friable, slightly sticky and slightly plastic; common very fine and fine roots; strongly effervescent; moderately alkaline; abrupt smooth boundary.

A12—3 to 8 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; strongly effervescent; moderately alkaline; clear smooth boundary.

B2ca—8 to 11 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate fine subangular blocky structure; slightly hard, friable, sticky and plastic; few very fine and fine roots; 5 percent coarse fragments coated with calcium carbonate; violently effervescent; moderately alkaline; abrupt wavy boundary.

C1ca—11 to 17 inches; brown (10YR 5/3) cobbly loam, dark brown (10YR 4/3) moist; massive; slightly hard, friable, sticky and slightly plastic; few very fine roots; 30 percent coarse fragments coated with calcium carbonate; violently effervescent; moderately alkaline; abrupt wavy boundary.

C3cam—17 to 20 inches; pink (7.5YR 7/4) indurated caliche.

Depth to the petrocalcic horizon ranges from 5 to 20 inches. The percentage of coarse fragments of very hard caliche and limestone, which are commonly on the surface and throughout the profile, is less than 35 percent.

The A horizon has hue of 7.5YR or 10YR, value of 4 to 6 when dry and 3 to 5 when moist, and chroma of 3 or 4.

The Cca horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 3 or 4. It is loam, clay loam, or cobbly loam. The Ccam horizon has hue of 7.5YR or 10YR, value of 7 or 8 when dry and 6 or 7 when moist, and chroma of 1 to 4. It is a strongly cemented layer, though in some pedons the surface is highly fractured.

Pecos Series

The soils in the Pecos series are classified as Torriertic Haplustolls, fine, mixed, thermic. These deep, moderately well drained, very slowly permeable soils are on flood plains. The soils formed in calcareous, saline, stratified, clayey alluvium. Slope is 0 to 1 percent. Elevation is 3,500 to 3,700 feet. The average annual precipitation is 11 to 12 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 200 to 210 days.

Typical pedon of Pecos silty clay loam; about 0.2 mile west of fence line, in the SE1/4SE1/4 of sec. 5, T. 7 S., R. 26 E.

Ap11—0 to 2 inches; reddish brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) moist; moderate thin platy structure; hard, friable, sticky and plastic; very few very fine soft masses of salt;

strongly effervescent; moderately alkaline; abrupt smooth boundary.

Ap12—2 to 8 inches; reddish brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) moist; strong coarse subangular blocky structure; hard, friable, sticky and plastic; very few very fine soft masses of salt; few cracks 0.5 inch wide extending to lower boundary; strongly effervescent; moderately alkaline; abrupt wavy boundary.

A13—8 to 12 inches; reddish brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; very few very fine filaments and soft masses of salt; cracks 0.5 inch wide extend to lower boundary; strongly effervescent; moderately alkaline; abrupt wavy boundary.

C1—12 to 22 inches; reddish brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) moist; massive; very hard, firm, sticky and plastic; few fine filaments and soft masses of salt; cracks 0.5 inch wide extend to lower boundary; strongly effervescent; moderately alkaline; gradual wavy boundary.

C2—22 to 35 inches; reddish brown (5YR 4/4) silty clay, dark reddish brown (5YR 3/4) moist; massive; hard, friable, sticky and plastic; common fine filaments and soft masses of salt; few cracks 0.5 inch wide; strongly effervescent; moderately alkaline; clear wavy boundary.

C3—35 to 42 inches; reddish brown (5YR 4/4) silty clay loam, dark reddish brown (5YR 3/4) moist; massive; hard, friable, sticky and plastic; common fine filaments and soft masses of salt; strongly effervescent; moderately alkaline; abrupt wavy boundary.

C4—42 to 45 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 3/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine soft masses of salt; strongly effervescent; moderately alkaline; abrupt wavy boundary.

C5—45 to 60 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; slightly effervescent; moderately alkaline.

Cracks 0.4 to 0.5 inch wide extend to a depth of 20 inches or more.

The A horizon has hue of 5YR or 7.5YR, value of 3 to 5 when dry and 2 to 4 when moist, and chroma of 2 or 3.

The C horizon has hue of 5YR or 7.5YR, value of 3 to 6 when dry and 2 to 5 when moist, and chroma of 2 to 6. It is clay, silty clay, or silty clay loam. In some pedons the lower part of the C horizon, below a depth of 42 inches, is stratified with layers of loam, silt loam, sandy clay loam, or fine sandy loam.

Pena Series

The soils in the Pena series are classified as Aridic Calciustolls, loamy-skeletal, mixed, mesic. These deep, well drained, moderately permeable soils are on gravelly alluvial ridges. The soils formed in alluvium derived mainly from mixed igneous and sedimentary rock. Slope is 5 to 15 percent. Elevation is 4,300 to 4,700 feet. The average annual precipitation is 14 to 15 inches. The average annual air temperature is 54 to 56 degrees F, and the frost-free season is 180 to 190 days.

Typical pedon of a Pena gravelly loam in an area of Hogadero-Pena association, moderately rolling; 250 feet south and 120 feet east of the SW1/4SW1/4 of sec. 18, T. 5 S., R. 20 E.

- A1—0 to 9 inches; dark grayish brown (10YR 4/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots and few fine and medium roots; 25 percent gravel and 3 percent cobbles; strongly effervescent; mildly alkaline; clear wavy boundary.
- AC—9 to 18 inches; pale brown (10YR 6/3) extremely gravelly clay loam, brown (10YR 5/3) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and few fine roots; common very fine pores; 50 percent gravel and 10 percent cobbles; common fine soft masses of calcium carbonate and disseminated calcium carbonate; hard lime coatings on underside of gravel; violently effervescent; moderately alkaline; clear wavy boundary.
- C1ca—18 to 25 inches; light yellowish brown (10YR 6/4) extremely gravelly clay loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine pores; 50 percent gravel and 15 percent cobbles; common fine soft masses of calcium carbonate and disseminated calcium carbonate; hard calcium carbonate coatings on underside of gravel; violently effervescent; moderately alkaline; gradual wavy boundary.
- C2ca—25 to 60 inches; very pale brown (10YR 7/4) extremely gravelly clay loam, light yellowish brown (10YR 6/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; 75 percent gravel and 5 percent cobbles; common large soft masses of calcium carbonate and disseminated calcium carbonate; hard calcium carbonate coatings on coarse fragments; violently effervescent; moderately alkaline.

Depth to the Cca horizon is 10 to 20 inches. The control section is 50 to 80 percent rock fragments. The content of rock fragments increases with depth.

The A horizon has value of 4 or 5 when dry and 3 or 4 when moist, and it has chroma of 2 or 3.

The AC horizon has value of 5 or 6 when dry and 4 or 5 when moist, and it has chroma of 3 or 4. It is extremely gravelly clay loam or extremely gravelly loam.

The Cca horizon has hue of 7.5YR or 10YR, value of 6 or 7 when dry and 5 or 6 when moist, and chroma of 4. It is extremely gravelly loam or extremely gravelly clay loam.

Philder Series

The soils in the Philder series are classified as Ustollic Paleorthids, loamy-skeletal, carbonatic, thermic, shallow. These shallow, well drained, moderately permeable soils are on high terraces. The soils formed in calcareous alluvium. Slope is 0 to 8 percent. Elevation is 3,650 to 4,000 feet. The average annual precipitation is 11 to 14 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 195 to 210 days.

Typical pedon of a Philder very gravelly fine sandy loam in an area of Torriorthents-Philder-Rock outcrop association, moderately steep; 528 feet east and 1,320 feet south of the northwest corner of sec. 31, T. 7 S., R. 27 E.

- A1—0 to 2 inches; brown (7.5YR 5/4) gravelly fine sandy loam, brown (7.5YR 4/4) moist; weak fine subangular blocky structure; soft, very friable; common fine roots; few very fine pores; 20 percent coarse fragments of calcium carbonate; slightly effervescent; mildly alkaline; abrupt wavy boundary.
- B2—2 to 8 inches; brown (7.5YR 5/4) very gravelly fine sandy loam, brown (7.5YR 4/4) moist; weak medium subangular blocky structure; soft, very friable; many fine roots and few medium roots; many very fine pores and few medium pores; 55 percent coarse fragments of calcium carbonate; strongly effervescent; moderately alkaline; abrupt wavy boundary.
- Ccam—8 to 12 inches; pink (5YR 8/3) indurated caliche, pink (5YR 8/4) moist; cementation decreases with depth; violently effervescent; moderately alkaline.

Depth to the petrocalcic horizon ranges from 7 to 20 inches.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 or 4. It is 20 to 30 percent rock fragments, of which 0 to 2 percent is cobbles and 15 to 28 percent is gravel.

The B horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 or 4. It is 40 to 60 percent coarse fragments, of which 2 to 10 percent is cobbles and 38 to 50 percent is gravel.

The Ccam horizon has chroma of 1 to 3.

Poquita Series

The soils in the Poquita series are classified as Ustollic Calciorthids, fine-silty, mixed, thermic. These deep, well drained, moderately permeable soils are on low ridges and in depressional areas on alluvial side slopes. The soils formed in calcareous alluvium. Slope is 0 to 3 percent. Elevation is 3,600 to 4,500 feet. The average annual precipitation is 11 to 14 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 195 to 210 days.

Typical pedon of a Poquita loam in an area of Alama-Poquita association, nearly level; 0.15 mile south of U.S.G.S. elevation marker K92 and 200 feet east, in sec. 1, T. 5 S., R. 22 E.

- A11—0 to 2 inches; reddish brown (5YR 5/4) very fine sandy loam, reddish brown (5YR 4/4) moist; weak medium platy structure; soft, very friable, slightly plastic; many very fine and fine roots; many very fine tubular pores; mildly alkaline; abrupt smooth boundary.
- A12—2 to 6 inches; yellowish red (5YR 5/6) loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine tubular pores; slightly effervescent; mildly alkaline; abrupt smooth boundary.
- B21—6 to 15 inches; reddish yellow (5YR 6/6) clay loam, reddish yellow (5YR 6/6) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; many very fine tubular pores; strongly effervescent; mildly alkaline; clear smooth boundary.
- B22ca—15 to 24 inches; reddish yellow (5YR 6/8) clay loam, yellowish red (5YR 5/8) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; many very fine tubular pores; common fine soft masses of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.
- C1ca—24 to 53 inches; light red (2.5YR 6/6) clay loam, red (2.5YR 4/6) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; common fine soft masses of calcium carbonate; strongly effervescent; mildly alkaline; clear smooth boundary.
- C2—53 to 60 inches; light red (2.5YR 6/6) loamy fine sand, red (2.5YR 4/6) moist; massive; slightly hard, very friable; few very fine roots; many very fine pores; few fine soft masses of calcium carbonate; strongly effervescent; moderately alkaline.

Depth to the calcic horizon ranges from 15 to 30 inches. Thickness of the solum ranges from 20 to 40 inches.

The A horizon has hue of 5YR or 7.5YR; value of 4 to 6 when dry and 3 to 5 when moist, and chroma of 2 to 6. It is fine sandy loam or loam.

The B horizon has hue of 2.5YR, 5YR, or 7.5YR, value of 4 to 6 when dry and 3 to 5 when moist, and chroma of 2 to 6. It is loam or clay loam. The Bca horizon has hue of 2.5YR, 5YR, or 7.5YR, value of 5 to 8 when dry and 4 to 6 when moist, and chroma of 4 to 8. It is loam or clay loam.

The C horizon has hue of 2.5YR, 5YR, or 7.5YR, value of 5 to 8 when dry and 4 to 6 when moist, and chroma of 4 to 6. It is loam or clay loam to a depth of about 40 inches and is loamy fine sand, loam, clay loam, or sandy clay loam below this depth.

Portales Series

The soils in the Portales series are classified as Aridic Calcistolls, fine-loamy, mixed, thermic. These deep, well drained, moderately permeable soils are in depressional areas and on alluvial side slopes and high plains. The soils formed in calcareous alluvium. Slope is 0 to 2 percent. Elevation is 4,100 to 4,500 feet. The average annual precipitation is 13 to 15 inches. The average annual air temperature is 58 to 61 degrees F, and the frost-free season is 185 to 205 days.

Typical pedon of Portales fine sandy loam, 0 to 2 percent slopes; 1.1 miles west of county road and 120 feet south of the road, in the NW1/4SE1/4 of sec. 31, T. 8 S., R. 33 E.

- A11—0 to 5 inches; very dark grayish brown (10YR 3/2) fine sandy loam, very dark brown (10YR 2/2) moist; moderate fine subangular blocky structure; slightly hard, very friable; many very fine roots; many very fine pores; slightly effervescent; mildly alkaline; clear smooth boundary.
- A12—5 to 17 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine pores; many fine filaments of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.
- B21—17 to 24 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable, sticky and plastic; common very fine roots; many very fine pores; few fine soft masses of calcium carbonate; violently effervescent; moderately alkaline; clear smooth boundary.
- B22ca—24 to 35 inches; light gray (10YR 7/2) clay loam, light brownish gray (10YR 6/2) moist; weak

fine subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; common very fine pores; common medium soft masses of calcium carbonate; violently effervescent; moderately alkaline; clear smooth boundary.

B23ca—35 to 52 inches; pink (7.5YR 7/4) sandy clay loam, light brown (7.5YR 6/4) moist; weak fine subangular structure; hard, friable, sticky and plastic; few very fine roots; common very fine pores; common medium soft masses of calcium carbonate; violently effervescent; moderately alkaline; clear smooth boundary.

C—52 to 63 inches; reddish yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) moist; massive; hard, friable, sticky and plastic; few fine pores; common fine seams of calcium carbonate; violently effervescent; moderately alkaline.

Depth to the calcic horizon ranges from 20 to 30 inches.

The A horizon has hue of 5YR, 7.5YR, or 10YR, value of 3 or 4 when dry and 2 or 3 when moist, and chroma of 2 or 3. It is fine sandy loam or loam.

The B21 horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 3 or 4. It is loam or clay loam. The Bca horizon has hue of 7.5YR or 10YR, value of 6 or 7 when dry and 5 or 6 when moist, and chroma of 2 to 4. It is loam, clay loam, or sandy clay loam.

The C horizon has hue of 5YR or 7.5YR, value of 6 to 8 when dry and 5 to 7 when moist, and chroma of 2 to 6.

Pyote Series

The soils in the Pyote series are classified as Arenic Ustalfic Haplargids, loamy, mixed, thermic. These deep, well drained, moderately rapidly permeable soils are on hummocks and ridges and in depressional areas on high terraces. The soils formed in alluvial and eolian deposits. Slope is 0 to 5 percent. Elevation is 3,900 to 4,200 feet. The average annual precipitation is 13 to 14 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 195 to 205 days.

Typical pedon of a Pyote fine sand in an area of Stromal-Pyote fine sands, gently undulating; 100 feet west and 0.5 mile south of windmill, in the NW1/4 of sec. 34, T. 9 S., R. 31 E.

A11—0 to 5 inches; brown (7.5YR 5/4) fine sand, dark brown (7.5YR 4/4) moist; single grain; loose; many very fine roots; neutral; abrupt smooth boundary.

A12—5 to 14 inches; light brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) moist; loose; very fine roots; neutral; clear smooth boundary.

A13—14 to 27 inches; reddish yellow (7.5YR 6/6) loamy fine sand, strong brown (7.5YR 5/6) moist; weak coarse subangular blocky structure; soft, very friable;

very fine roots; many very fine pores; neutral; clear smooth boundary.

B2t—27 to 42 inches; strong brown (7.5YR 5/6) fine sandy loam, strong brown (7.5YR 4/6) moist; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky; few very fine roots; common very fine pores; bridges and patchy films of clay; neutral; clear smooth boundary.

C1—42 to 60 inches; pink (7.5YR 7/4) loamy fine sand, light brown (7.5YR 6/4) moist; massive; soft, very friable; few fine roots; common very fine pores; mildly alkaline.

Thickness of the solum ranges from 40 to 80 inches. Some pedons have a calcic horizon below a depth of 60 inches.

The A horizon has hue of 5YR or 7.5YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 4 to 6. It is fine sand or loamy fine sand.

The B1 horizon, where present, has hue of 5YR or 7.5YR, value of 4 or 5 when moist, and chroma of 4 to 6. The Bt horizon has hue of 5YR or 7.5YR, value of 5 or 6 when dry and 4 to 6 when moist, and chroma of 4 to 6.

The C horizon has hue of 5YR or 7.5YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 4 to 6. It is loamy fine sand or fine sand and is less than 15 percent calcium carbonate.

Ranstein Series

The soils in the Ranstein series are classified as Aridic Argiustolls, fine-silty, mixed, thermic. These deep, well drained, moderately slowly permeable soils are on bottom lands and in depressional areas of upland plains and valleys. The soils formed in calcareous alluvium derived mainly from limestone. Slope is 0 to 1 percent. Elevation is 4,000 to 4,300 feet. The average annual precipitation is 13 to 14 inches. The average annual air temperature is 58 to 60 degrees F, and the frost-free season is 190 to 200 days.

Typical pedon of a Ranstein silt loam in an area of Hodgins-Ranstein association, gently undulating; 2,250 feet south and 1,300 feet west of the northeast corner of sec. 30, T. 8 S., R. 22 E.

A1—0 to 3 inches; brown (10YR 5/3) silt loam, very dark grayish brown (10YR 3/2) moist; moderate thin platy structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots and common fine roots; many very fine pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

B21t—3 to 10 inches; brown (10YR 5/3) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; few fine roots; few fine pores; thin patchy clay films on faces of peds and in pores; moderately alkaline; abrupt wavy boundary.

B22t—10 to 24 inches; brown (10YR 5/3) silty clay loam, dark grayish brown (10YR 4/2) moist; strong coarse subangular blocky structure; hard, firm, sticky and plastic; few fine roots; few fine tubular pores; clay films in pores and patchy films on faces of peds; few fine soft masses of calcium carbonate; strongly calcareous; moderately alkaline; clear wavy boundary.

B23t—24 to 49 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; few fine roots; few fine pores; thin patchy clay films on faces of peds and in pores; few fine soft masses of calcium carbonate; strongly calcareous; moderately alkaline; clear wavy boundary.

C1ca—49 to 60 inches; yellowish brown (10YR 5/4) silt loam, brown (10YR 4/3) moist; massive; slightly hard, friable, sticky and plastic; few fine soft masses of calcium carbonate; violently effervescent; moderately alkaline.

The solum is 40 to 60 inches thick.

The A1 horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 2 or 3.

The B21t horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 2 or 3. The B22t and B23t horizons have hue of 7.5YR or 10YR, value of 5 or 6 when dry and 3 or 4 when moist, and chroma of 3 or 4. The B horizon is silt loam or silty clay loam.

The C1ca horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 3 or 4 when moist, and chroma of 3 or 4. It is silt loam or silty clay loam.

Ratliff Series

The soils in the Ratliff series are classified as Ustollic Calciorthids, fine-loamy, mixed, thermic. These deep, well drained, moderately permeable soils are on ridges, on alluvial side slopes, and in depressional areas on high plains and terraces. The soils formed in calcareous alluvium. Slope is 0 to 2 percent. Elevation is 3,750 to 4,700 feet. The average annual precipitation is 13 to 15 inches. The average annual air temperature is 58 to 61 degrees F, and the frost-free season is 185 to 210 days.

Typical pedon of a Ratliff fine sandy loam in an area of Blakeney-Ratliff association, moderately undulating; 1 mile south of the Mountain Bell microwave tower on Highway 70 and 100 feet west of dirt road, in the NE1/4NE1/4 of sec. 24, T. 8 S., R. 26 E.

A11—0 to 2 inches; reddish brown (5YR 5/3) fine sandy loam, reddish brown (5YR 4/3) moist; moderate medium granular structure and moderate fine platy; soft, very friable, slightly sticky; many fine roots; few medium pores and many fine pores; common fine

concretions of calcium carbonate; strongly effervescent; moderately alkaline; abrupt wavy boundary.

A12—2 to 6 inches; reddish brown (5YR 5/3) fine sandy loam, reddish brown (5YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky; few very fine and fine roots; many fine pores; few fine concretions of calcium carbonate; violently effervescent; moderately alkaline; clear wavy boundary.

B21—6 to 18 inches; reddish brown (5YR 5/3) sandy clay loam, reddish brown (5YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few medium pores and many very fine pores; few fine concretions of calcium carbonate; violently effervescent; moderately alkaline; clear wavy boundary.

B22—18 to 26 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; few very fine roots; many very fine pores; few fine concretions of calcium carbonate; violently effervescent; moderately alkaline; clear wavy boundary.

B23ca—26 to 36 inches; light reddish brown (5YR 6/4) sandy clay loam, reddish brown (5YR 5/4) moist; weak medium subangular blocky structure; hard, friable, sticky and slightly plastic; few very fine roots; many very fine pores; common fine concretions of calcium carbonate; strongly effervescent; moderately alkaline; abrupt wavy boundary.

B24ca—36 to 60 inches; white (N 8/0) sandy clay loam, pink (7.5YR 8/4) moist; weak medium subangular blocky structure; extremely firm, extremely hard, sticky and slightly plastic; many very fine pores; disseminated calcium carbonate and hard masses of calcium carbonate; strongly effervescent; moderately alkaline.

Depth to the calcic horizon ranges from 20 to 40 inches. Thickness of the solum is more than 60 inches.

The A horizon has hue of 5YR, 7.5YR, or 10YR and chroma of 2 to 4. It is fine sandy loam or loam.

The B2 horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 to 7 when dry and 3 to 6 when moist, and chroma of 3 to 6. It is loam, clay loam, or sandy clay loam. The B2ca horizon has hue of 5YR or 7.5YR, value of 6 to 8 when dry and 4 to 8 when moist, and chroma of 0 to 8. It is loam or sandy clay loam. Calcium carbonate ranges from concretions to a powdery form.

Reagan Series

The soils in the Reagan series are classified as Ustollic Calciorthids, fine-silty, mixed, thermic. These deep, well drained, moderately permeable soils are on

alluvial side slopes, on alluvial fans, and in depressional areas on uplands. The soils formed in calcareous alluvium. Slope is 0 to 2 percent. Elevation is 3,900 to 4,700 feet. The average annual precipitation is 13 to 14 inches. The average annual air temperature is 58 to 60 degrees F, and the frost-free season is 190 to 200 days.

Typical pedon of a Reagan silt loam in an area of Reagan-Conger association, moderately undulating; 2.3 miles south of Pine Lodge Road, 0.95 mile northeast to cross trail, and then 0.3 mile south and 100 feet east of the road in the NW1/4NE1/4 of sec. 31, T. 9 S., R. 22 E.

A11—0 to 3 inches; yellowish brown (10YR 5/4) silt loam, dark yellowish brown (10YR 4/4) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; common fine and very fine roots; common very fine pores; moderately alkaline; abrupt smooth boundary.

A12—3 to 10 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; moderate very fine and fine subangular blocky structure; slightly hard, friable, sticky and plastic; few fine and very fine roots; common fine and medium pores; slightly effervescent; moderately alkaline; clear smooth boundary.

B21—10 to 16 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; common very fine, fine, and medium pores; slightly effervescent; moderately alkaline; clear smooth boundary.

B22—16 to 24 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; few very fine roots; common very fine, fine, and medium pores; few fine soft masses of calcium carbonate in lower part of the horizon; strongly effervescent; moderately alkaline; clear wavy boundary.

B23ca—24 to 33 inches; light brown (7.5YR 6/4) silty clay loam, brown (7.5YR 5/4) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; common fine pores; common medium soft masses of calcium carbonate; strongly effervescent; moderately alkaline; diffuse wavy boundary.

B24ca—33 to 44 inches; pink (7.5YR 7/4) silty clay loam, light brown (7.5YR 6/4) moist; weak coarse prismatic structure parting to weak medium subangular blocky; hard, friable, sticky and plastic; common fine pores; few fine and medium soft masses of calcium carbonate; strongly effervescent; moderately alkaline; diffuse wavy boundary.

Cca—44 to 60 inches; pink (7.5YR 7/4) silty clay loam, light brown (7.5YR 6/4) moist; massive; hard, friable,

sticky and plastic; few fine pores; few fine soft masses of calcium carbonate; strongly effervescent; moderately alkaline.

Depth to the calcic horizon ranges from 20 to 30 inches. Thickness of the solum ranges from 40 to 50 inches.

The A horizon has hue of 7.5YR or 10YR, and it has chroma of 3 or 4 when moist.

The B2 horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 3 or 4. It is less than 5 percent visible calcium carbonate to a depth of 20 inches. The B2ca horizon has hue of 7.5YR or 10YR, and it has value of 6 or 7 when dry and 5 or 6 when moist.

The C horizon has value of 6 or 7 when dry and 5 or 6 when moist.

Reakor Series

The soils in the Reakor series are classified as Typic Calciorthiss, fine-silty, mixed, thermic. These deep, well drained, moderately permeable soils are on alluvial side slopes and in depressional areas in broad valleys and on low terraces. The soils formed in calcareous alluvial material derived mainly from limestone. They contain some eolian material. Slope is 0 to 3 percent. Elevation is 3,550 to 4,200 feet. The average annual precipitation is 11 to 12 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 200 to 210 days.

Typical pedon of Reakor silt loam, 0 to 3 percent slopes; 0.1 mile east of fence brace and 1.9 miles north of main road, at the southwest corner of NW1/4NW1/4 of sec. 18, T. 19 S., R. 24 E.

A11—0 to 3 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; moderate thin platy structure and weak fine granular; soft, very friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine pores; strongly effervescent; moderately alkaline; clear smooth boundary.

A12—3 to 7 inches; yellowish brown (10YR 5/4) silt loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots and few fine roots; common very fine pores and few medium pores; strongly effervescent; moderately alkaline; clear smooth boundary.

B21—7 to 22 inches; light yellowish brown (10YR 6/4) silty clay loam, yellowish brown (10YR 5/4) moist; weak coarse subangular blocky structure; slightly hard, friable, sticky and plastic; few fine and very fine roots; common very fine pores and few fine pores; few fine filaments and soft masses of calcium

carbonate; strongly effervescent; moderately alkaline; clear wavy boundary.

B22ca—22 to 38 inches; pink (7.5YR 7/4) silty clay loam, light brown (7.5YR 6/4) moist; strong coarse subangular blocky structure; hard, friable, sticky and plastic; few fine roots; few fine pores; common medium and few fine soft masses of calcium carbonate; violently effervescent; moderately alkaline; clear smooth boundary.

C1ca—38 to 50 inches; light brown (7.5YR 6/4) silty clay loam, brown (7.5YR 5/4) moist; massive; hard, friable, sticky and plastic; few fine soft masses of calcium carbonate; violently effervescent; moderately alkaline; clear smooth boundary.

C2ca—50 to 60 inches; pink (7.5YR 7/4) silty clay loam, light brown (7.5YR 6/4) moist; massive; hard, friable, sticky and plastic; common medium soft masses of calcium carbonate; violently effervescent; moderately alkaline.

Depth to the calcic horizon ranges from 20 to 30 inches. The control section is less than 15 percent sand that is fine or coarser.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 3 or 4 when moist, and chroma of 2 to 4.

The B21 horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 3 or 4. It is silt loam or silty clay loam.

The Cca horizon has value of 6 to 8 when dry and 5 to 7 when moist. It is silt loam or silty clay loam.

Reakor Variant

The soils in the Reakor Variant are classified as Typic Calciorthisds, fine-loamy, mixed, thermic. These deep, well drained, moderately permeable soils are on terraces and ridges. The soils formed in calcareous alluvium derived mainly from limestone. Slope is 0 to 3 percent. Elevation is 3,600 to 3,750 feet. The average annual precipitation is 11 to 12 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 200 to 210 days.

Typical pedon of Reakor Variant loam; 700 feet east and 400 feet south of the corner of the NW1/4SW1/4 of sec. 31, T. 24 E., R. 7 S.

Ap—0 to 8 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) moist; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine and fine pores; strongly effervescent; moderately alkaline; clear smooth boundary.

B1—8 to 22 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) moist; moderate fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots and common fine roots; common very fine and fine

pores and few medium pores; strongly effervescent; moderately alkaline; clear smooth boundary.

B21—22 to 30 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and common fine roots; common very fine and few fine pores; 10 percent pebbles; few fine soft masses of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

IIB22ca—30 to 38 inches; pink (7.5YR 7/4) very gravelly clay loam, light brown (7.5YR 6/4) moist; moderate fine subangular blocky structure; hard, friable, sticky and plastic; common very fine and few medium roots; common very fine and few fine pores; 40 percent gravel; common fine soft masses of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

IIC1—38 to 55 inches; pink (7.5YR 7/4) gravelly clay loam, light brown (7.5YR 6/4) moist; massive; hard, friable, sticky and plastic; common very fine roots; common very fine pores; 30 percent gravel; common medium and few large soft masses of calcium carbonate; strongly effervescent; moderately alkaline; gradual smooth boundary.

IIC2—55 to 60 inches; pink (5YR 7/4) clay loam, light reddish brown (5YR 6/4) moist; massive; hard, friable, sticky and plastic; 25 percent gravel; common medium and few large soft masses of calcium carbonate; violently effervescent; moderately alkaline.

Depth to gravelly deposits is 25 to 30 inches. The weighted average content of gravel in the control section is more than 15 percent.

The A horizon has hue of 7.5YR or 10YR, value of 4 to 6 when dry and 3 to 5 when moist, and chroma of 2 to 4.

The B horizon has hue of 7.5YR or 10YR, and it has value of 6 or 7 when dry and 4 or 5 when moist. It is loam or clay loam.

The IIB horizon has value of 6 or 7 when dry and 5 or 6 when moist. It is very gravelly clay loam, gravelly loam, very gravelly loam, or gravelly clay loam. It is 25 to 50 percent gravel.

The IIC horizon has hue of 5YR or 7.5YR, and it has value of 6 or 7 when dry and 5 or 6 when moist. It is gravelly clay loam, gravelly loam, or clay loam.

Redona Series

The soils in the Redona series are classified as Ustollic Haplargids, fine-loamy, mixed, thermic. These deep, well drained, moderately permeable soils are on low ridges and in depressional areas on high terraces. The soils formed in calcareous alluvium. Slope is 0 to 2 percent. Elevation is 3,800 to 4,500 feet. The average

annual precipitation is 13 to 14 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 195 to 205 days.

Typical pedon of a Redona fine sandy loam in an area of Ratliff-Redona association, gently undulating; 1,584 feet west and 2,640 feet south of the northeast corner of sec. 34, T. 8 S., R. 30 E.

A11—0 to 4 inches; reddish brown (5YR 5/3) fine sandy loam, dark reddish brown (5YR 3/2) moist; moderate thin platy structure; soft, very friable; common very fine and fine roots; common very fine and fine pores; mildly alkaline; clear smooth boundary.

A12—4 to 12 inches; reddish brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure; soft, very friable; slightly plastic; common very fine and fine roots; common very fine and fine pores; mildly alkaline; clear smooth boundary.

B21t—12 to 19 inches; reddish brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine and fine pores; thin clay coatings on sand grains and bridging grains, and thin patchy clay films on faces of peds and in pores; mildly alkaline; clear smooth boundary.

B22t—19 to 29 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and plastic; common very fine and fine roots; common very fine and fine pores; thin clay coatings on sand grains and bridging grains, and few thin patchy clay films on faces of peds and in pores; mildly alkaline; gradual wavy boundary.

B23tca—29 to 39 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and plastic; common very fine and fine roots; common very fine and fine pores; thin clay coatings on sand grains and bridging grains, and few thin clay films in pores; common masses of calcium carbonate; violently effervescent; moderately alkaline; gradual wavy boundary.

B3ca—39 to 60 inches; light reddish brown (5YR 6/4) sandy clay loam, reddish brown (5YR 5/4) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and plastic; few fine roots; few fine pores; disseminated calcium carbonate; violently effervescent; moderately alkaline; clear smooth boundary.

C1ca—60 to 65 inches; pink (7.5YR 8/4) clay loam, light brown (7.5YR 6/4) moist; massive; hard, friable,

sticky and plastic; disseminated calcium carbonate; violently effervescent; moderately alkaline.

The solum is 36 to 60 inches thick. Depth to the calcic horizon ranges from 20 to 40 inches.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 2 to 4. It is fine sandy loam or loam.

The Bt horizon has hue of 2.5YR, 5YR, or 7.5YR, value of 4 or 5 when dry and 3 to 5 when moist, and chroma of 4 to 6. It is sandy clay loam or clay loam.

The C horizon has hue of 5YR or 7.5YR. It is sandy clay loam or clay loam.

Reeves Series

The soils in the Reeves series are classified as Typic Gypsiorthids, fine-loamy, gypsic, thermic. These deep, well drained, moderately permeable soils are on low ridges, on smooth side slopes, and in depressional areas on high terraces. The soils formed in alluvium derived dominantly from calcareous material high in content of gypsum. Slope is 0 to 3 percent. Elevation is 3,550 to 4,500 feet. The average annual precipitation is 11 to 14 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 195 to 210 days.

Typical pedon of a Reeves loam in an area of Hollomex-Reeves-Milner, dry loams, gently undulating; 36 feet east of the southeast corner of oil pad, in the SW1/4SW1/4NW1/4 of sec. 27, T. 10 S., R. 26 E.

A11—0 to 3 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 4/4) moist; moderate fine platy structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common very fine and fine pores; strongly effervescent; moderately alkaline; abrupt smooth boundary.

A12—3 to 8 inches; brown (7.5YR 5/4) loam, brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many very fine and fine pores; few fine soft masses of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

B21ca—8 to 14 inches; yellowish red (5YR 5/6) loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; slightly hard, friable, sticky and plastic; few fine and common very fine roots; many very fine pores; common fine soft masses and filaments of calcium carbonate; strongly effervescent; moderately alkaline; clear wavy boundary.

B22ca—14 to 24 inches; reddish yellow (5YR 6/8) clay loam, yellowish red (5YR 5/8) moist; moderate fine, subangular blocky structure; slightly hard, friable, sticky and plastic; few very fine roots and few medium roots; many very fine pores; many medium

soft masses and filaments of calcium carbonate; violently effervescent; moderately alkaline; abrupt wavy boundary.

C1cs—24 to 31 inches; reddish yellow (5YR 6/6) gypsiferous sandy loam, yellowish red (5YR 5/6) moist; massive; hard, firm, slightly sticky and slightly plastic; few very fine roots and few medium roots; few very fine pores; disseminated and soft masses of calcium carbonate and gypsum crystals; strongly effervescent; mildly alkaline; gradual wavy boundary.

C2cs—31 to 60 inches; yellowish red (5YR 5/6) gypsiferous loam, yellowish red (5YR 4/6) moist; massive; hard, firm, slightly sticky and slightly plastic; disseminated and soft masses of calcium carbonate and gypsum crystals; violently effervescent; mildly alkaline.

Depth to the gypsic horizon ranges from 20 to 40 inches. The control section is 40 to 65 percent gypsum and calcium carbonate.

The A horizon has hue of 5YR or 7.5YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 3 or 4. It is loam or fine sandy loam.

The B horizon has value of 5 to 7 when dry and 4 to 6 when moist, and it has chroma of 3 to 8. It is loam or clay loam.

The Ccs horizon has an apparent texture of loam or sandy loam and ranges widely in color.

Roswell Series

The soils in the Roswell series are classified as Ustic Torripsamments, mixed, thermic. These deep, excessively drained, rapidly permeable soils are on coppice dunes of high terraces. The soils formed in eolian deposits. Slope is 2 to 30 percent. Elevation is 3,800 to 4,200 feet. The average annual precipitation is 13 to 14 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 195 to 205 days.

Typical pedon of Roswell fine sand, 10 to 30 percent slopes; 0.44 mile north-northwest and 15 feet east of picnic area on U.S. Highway 380, in the SW1/4NE1/4 of sec. 30, T. 10 S., R. 30 E.

A11—0 to 11 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grain; loose; few very fine roots; many fine irregular pores; mildly alkaline; gradual wavy boundary.

A12—11 to 19 inches; light yellowish brown (10YR 6/4) fine sand, yellowish brown (10YR 5/4) moist; single grain; loose; few very fine roots; many fine irregular pores; mildly alkaline; gradual wavy boundary.

C—19 to 60 inches; light brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) moist; single grain; loose; few very fine roots; many irregular pores; mildly alkaline.

The combined A and C horizons are fine sand or loamy fine sand more than 60 inches thick.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 3 or 4.

The C horizon has hue of 5YR, 7.5YR, or 10YR, value of 6 or 7 when dry, and chroma of 4 to 6.

Sharvana Series

The soils in the Sharvana series are classified as Petrocalcic Ustalfic Paleargids, loamy, mixed, thermic, shallow. These shallow, well drained, moderately permeable soils are on ridges of high plains and high terraces. The soils formed in alluvium. Slope is 0 to 2 percent. Elevation is 3,800 to 4,700 feet. The average annual precipitation is 13 to 15 inches. The average annual air temperature is 58 to 61 degrees F, and the frost-free season is 185 to 205 days.

Typical pedon of Sharvana fine sandy loam, dry; 2,112 feet north and 200 feet west of the southeast corner of sec. 6, T. 9 S., R. 31 E.

A1—0 to 3 inches; reddish brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak fine granular structure; soft, very friable; common very fine roots; common fine pores; neutral; abrupt smooth boundary.

B2t—3 to 14 inches; reddish brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; moderate coarse prismatic structure parting to weak fine subangular blocky; slightly hard, friable, slightly sticky and plastic; common very fine roots; common fine pores; thin patchy clay films on faces of peds and in pores; mildly alkaline; clear wavy boundary.

Ccam—14 inches; white indurated caliche.

Depth to the petrocalcic horizon ranges from 8 to 20 inches.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 or 4. It is fine sandy loam or loam.

The Bt horizon has value of 4 or 5 when dry and 3 or 5 when moist, and it has chroma of 3 or 4. It is sandy clay loam or fine sandy loam.

The Ccam horizon is indurated to strongly cemented and becomes less cemented with depth.

Simona Series

The soils in the Simona series are classified as Typic Paleorthids, loamy, mixed, thermic, shallow. These shallow, well drained, moderately rapidly permeable soils are on ridges and high terraces. The soils formed in calcareous alluvial and eolian deposits. Slope is 2 to 5 percent. Elevation is 3,700 to 3,800 feet. The average annual precipitation is 11 to 12 inches. The average

annual air temperature is 59 to 61 degrees F, and the frost-free season is 200 to 210 days.

Typical pedon of a Simona fine sandy loam (fig. 9) in an area of Sotim-Simona association, moderately undulating; 1,584 feet west and 2,112 feet north of the southeast corner of sec. 6. T. 9 S.. R. 26 E.

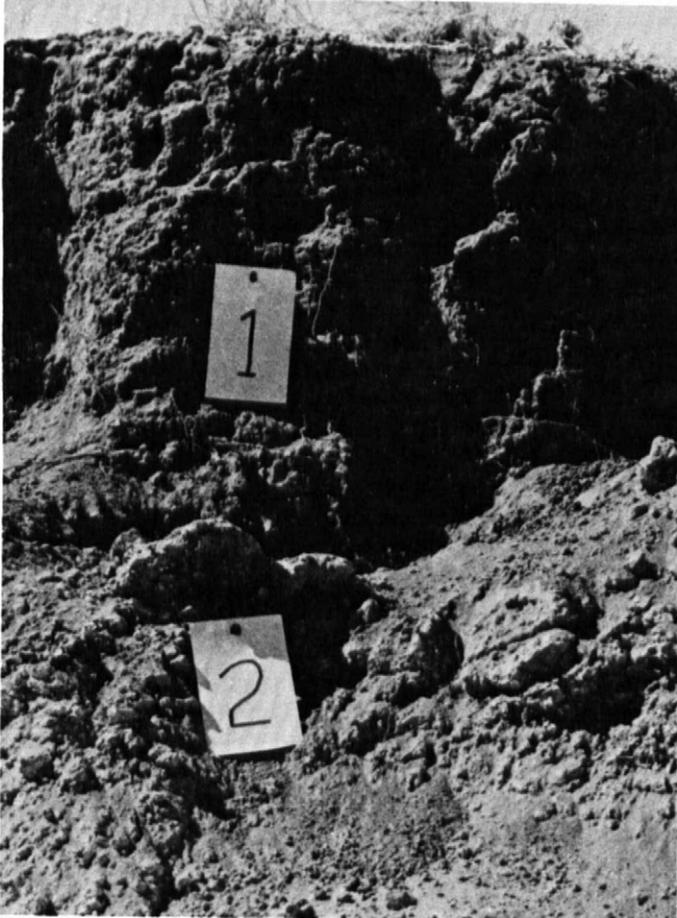


Figure 9.—Profile of Simona fine sandy loam, which is shallow to indurated caliche. Markers show depth in feet.

- A11—0 to 2 inches; reddish brown (5YR 5/3) fine sandy loam, dark reddish brown (5YR 3/3) moist; moderate thin platy structure; soft, very friable; common fine and medium roots; disseminated calcium carbonate; strongly effervescent; moderately alkaline; abrupt smooth boundary.
- A12—2 to 7 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly plastic; common fine and medium roots; few fine tubular pores; 5 percent pebbles; disseminated calcium carbonate; strongly effervescent; moderately alkaline; clear wavy boundary.

B2—7 to 14 inches; reddish brown (5YR 5/4) gravelly fine sandy loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly plastic; few fine and medium roots; few fine tubular pores; 20 percent pebbles; disseminated calcium carbonate; very strongly calcareous; moderately alkaline; abrupt wavy boundary.

Ccam—14 inches; white (N 8/0) indurated caliche.

Depth to the petrocalcic horizon is 7 to 20 inches. The content of coarse fragments is 1 to 30 percent. The solum typically is strongly effervescent throughout, but some pedons are noneffervescent in the upper few inches.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 or 4. It is less than 0.5 percent organic carbon.

The B horizon has hue of 5YR or 7.5YR, and it has value of 5 or 6 when dry and 4 or 5 when moist. It is sandy loam, fine sandy loam, or loam. It is 5 to 30 percent coarse fragments.

Slaughter Series

The soils in the Slaughter series are classified as Petrocalcic Paleustolls, clayey, mixed, thermic, shallow. These shallow, well drained, moderately slowly permeable soils are in depressional areas on upland plains. The soils formed in calcareous alluvium. Slope is 0 to 1 percent. Elevation is 4,300 to 4,500 feet. The average annual precipitation is 14 to 15 inches. The average annual air temperature is 58 to 60 degrees F, and the frost-free season is 185 to 195 days.

Typical pedon of a Slaughter clay loam in an area of Kimbrough-Slaughter complex, gently undulating; 0.35 mile north and 10 feet east of fence corner, in the NE1/4 of sec. 26, T. 10 S., R. 31 E.

- A11—0 to 2 inches; brown (7.5YR 4/2) fine sandy loam, dark brown (7.5YR 3/2) moist; moderate medium platy structure; soft, very friable; common very fine and fine roots; common very fine pores; mildly alkaline; abrupt smooth boundary.
- A12—2 to 5 inches; brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; common very fine pores; mildly alkaline; abrupt smooth boundary.
- B2t—5 to 14 inches; reddish brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) moist; strong medium subangular blocky structure; very hard, firm, very sticky and very plastic; common very fine and fine roots; common very fine pores; thin patchy clay films; slightly effervescent; mildly alkaline; abrupt wavy boundary.

Ccam—14 inches; white (10YR 8/1) continuously indurated caliche.

Depth to the petrocalcic horizon ranges from 9 to 20 inches.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 2 or 3.

The Bt horizon has hue of 5YR or 7.5YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 2 to 4. It is clay loam or clay.

Sotim Series

The soils in the Sotim series are classified as Typic Calciorthids, fine-loamy, mixed, thermic. These deep, well drained, moderately slowly permeable soils are on alluvial side slopes, on low ridges, and in depressional areas on high terraces. The soils formed in alluvium derived mainly from loamy, calcareous material. Slope is 0 to 2 percent. Elevation is 3,650 to 3,800 feet. The average annual precipitation is 11 to 12 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 200 to 210 days.

Typical pedon of a Sotim fine sandy loam in an area of Sotim-Simona association, moderately undulating; 2,000 feet south and 100 feet west of the northeast corner of sec. 6, T. 9 S., R. 26 E.

A1—0 to 7 inches; reddish brown (5YR 5/3) fine sandy loam, reddish brown (5YR 4/3) moist; weak medium granular structure; soft, very friable; common fine and medium roots; strongly effervescent; moderately alkaline; abrupt smooth boundary.

B21—7 to 15 inches; reddish brown (5YR 5/3) loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots; many fine tubular pores; few fine concretions of calcium carbonate; strongly effervescent; moderately alkaline; clear wavy boundary.

B22—15 to 30 inches; light reddish brown (5YR 6/4) loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots; many fine tubular pores; few fine concretions of calcium carbonate; strongly effervescent; moderately alkaline; abrupt wavy boundary.

C1ca—30 to 60 inches; pink (5YR 7/4) clay loam, reddish brown (5YR 5/4) moist; massive; hard, firm, slightly sticky and slightly plastic; few medium roots; few fine tubular pores; many fine concretions and soft masses of calcium carbonate and disseminated calcium carbonate; very strongly effervescent; moderately alkaline.

Depth to the calcic horizon ranges from 20 to 40 inches. The control section is 15 to 35 percent calcium carbonate.

The A horizon has value of 4 to 6 when dry and 3 or 4 when moist, and it has chroma of 3 or 4.

The B horizon has hue of 5YR or 7.5YR, value of 4 to 6 when dry and 3 or 4 when moist, and chroma of 3 or 4. It is loam or clay loam.

The Cca horizon has hue of 2.5YR, 5YR, or 7.5YR, value of 6 or 7 when dry and 4 or 5 when moist, and chroma of 4 to 6. It is loam or clay loam.

Stromal Series

The soils in the Stromal series are classified as Arenic Ustalfic Haplargids, loamy, mixed, thermic. These deep, well drained, moderately rapidly permeable soils are on low ridges of high terraces. The soils formed in calcareous alluvial and eolian deposits. Slope is 0 to 2 percent. Elevation is 4,000 to 4,100 feet. The average annual precipitation is 13 to 14 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 195 to 205 days.

Typical pedon of a Stromal fine sand in an area of Stromal-Pyote fine sands, gently undulating; 80 feet east and 0.4 mile south of windmill, in the NE1/4SE1/4 of sec. 34, T. 9 S., R. 31 E.

A11—0 to 8 inches; brown (10YR 5/3) fine sand, brown (10YR 4/3) moist; weak fine granular structure; soft, very friable; many very fine roots; common very fine pores; neutral; clear wavy boundary.

A12—8 to 17 inches; yellowish brown (10YR 5/4) fine sand, dark yellowish brown (10YR 4/4) moist; weak medium granular structure; soft, very friable; many very fine roots; common very fine pores; neutral; clear wavy boundary.

B21t—17 to 24 inches; light yellowish brown (10YR 6/4) loamy fine sand, yellowish brown (10YR 5/4) moist; weak coarse subangular blocky structure; slightly hard, friable; many very fine roots; common very fine pores; common fine clay bridges between sand grains; mildly alkaline; clear wavy boundary.

B22tca—24 to 28 inches; very pale brown (10YR 7/3) fine sandy loam, pale brown (10YR 6/3) moist; moderate coarse subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common very fine roots; common very fine pores; few thin clay films on faces of peds and in pores; many medium concretions of calcium carbonate; moderately alkaline; clear wavy boundary.

C1ca—28 to 50 inches; white (10YR 8/1) heavy fine sandy loam, light gray (10YR 7/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine pores; disseminated calcium carbonate; moderately alkaline; clear wavy boundary.

C2—50 to 60 inches; very pale brown (10YR 7/3) loamy fine sand, light gray (10YR 7/2) moist; single grain; loose; disseminated calcium carbonate; moderately alkaline.

Depth to the calcic horizon ranges from 20 to 40 inches. Depth to textures finer than loamy fine sand is 20 to 30 inches. The thickness of the solum is 24 to 40 inches.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 3 to 5 when moist, and chroma of 3 or 4.

The Bt horizon has hue of 7.5YR or 10YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 3 or 4.

The Cca horizon has hue of 7.5YR or 10YR, value of 7 or 8 when dry and 6 or 7 when moist, and chroma of 1 to 3. It is 15 to 25 percent calcium carbonate.

Threadgill Series

The soils in the Threadgill series are classified as Ustollic Camborthids, fine-silty, mixed, mesic. These deep, well drained, moderately slowly permeable soils are in drainageways and on foot slopes and alluvial side slopes of uplands. The soils formed in calcareous alluvium derived mainly from limestone. Slope is 0 to 5 percent. Elevation is 4,200 to 4,700 feet. The average annual precipitation is 14 to 15 inches. The average annual air temperature is 54 to 56 degrees F, and the frost-free season is 180 to 190 days.

Typical pedon of a Threadgill silt loam in an area of Threadgill-Gabaldon association, gently sloping; 1,584 feet east and 1,056 feet north of the southwest corner of sec. 18, T. 5 S., R. 21 E.

A1—0 to 5 inches; dark yellowish brown (10YR 4/4) silt loam, dark brown (10YR 3/3) moist; moderate fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots and common fine roots; many fine and very fine pores; strongly effervescent; mildly alkaline; clear smooth boundary.

B21—5 to 12 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure parting to moderate fine granular; slightly hard, very friable, sticky and plastic; common very fine and fine roots; many very fine and fine pores; few fine soft masses of calcium carbonate and disseminated calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

B22ca—12 to 18 inches; light brown (7.5YR 6/4) silty clay loam, brown (7.5YR 5/4) moist; moderate medium subangular blocky structure; slightly hard, very friable, sticky and plastic; few very fine and fine roots; common very fine and fine pores; common fine soft masses of calcium carbonate and

disseminated calcium carbonate; violently effervescent; moderately alkaline; clear smooth boundary.

B23ca—18 to 36 inches; light brown (7.5YR 6/4) silty clay loam, light brown (7.5YR 6/4) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, sticky and plastic; few fine and very fine roots; common fine and very fine pores; many fine and few medium soft masses of calcium carbonate; violently effervescent; moderately alkaline; gradual smooth boundary.

C1ca—36 to 60 inches; light brown (7.5YR 6/4) silty clay loam, brown (7.5YR 5/4) moist; massive; slightly hard, friable, sticky and plastic; few fine soft masses of calcium carbonate and disseminated calcium carbonate; violently effervescent; moderately alkaline.

The solum ranges from 20 to 40 inches in thickness.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 2 to 4.

The B horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 3 or 4. It is clay loam or silty clay loam.

The C horizon is clay loam or silty clay loam.

Torriorthents

Torriorthents are shallow to deep, well drained, moderately permeable to moderately rapidly permeable soils on elevation breaks and escarpments. The soils formed in calcareous alluvium, colluvium, and residuum. Slope is 2 to 30 percent. Elevation is 3,650 to 4,700 feet. The average annual precipitation is 11 to 14 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 195 to 210 days.

Reference pedon of Torriorthents in an area of Torriorthents-Philder-Rock outcrop association, moderately steep; 1,250 feet east and 200 feet north of the southwest corner of sec. 30, T. 7 S., R. 27 E.

A1—0 to 4 inches; yellowish red (5YR 4/6) fine sandy loam, yellowish red (5YR 3/6) moist; moderate medium platy structure; soft, very friable; few very fine and fine roots; few fine filaments of calcium carbonate; strongly effervescent; moderately alkaline; clear wavy boundary.

C1—4 to 10 inches; reddish brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; massive; slightly hard, friable; few fine roots; few fine pores; few fine filaments of calcium carbonate; strongly effervescent; moderately alkaline; abrupt irregular boundary.

R—10 inches; sandstone.

These soils are extremely variable in characteristics. Texture is fine sandy loam to sandy clay loam. Rock fragment content ranges from 5 to 25 percent.

Tucumcari Series

The soils in the Tucumcari series are classified as Ustollic Haplargids, fine, mixed, thermic. These deep, well drained, moderately slowly permeable soils are in large depressional areas, in basins, and in valleys. The soils formed in calcareous alluvium derived mainly from red siltstone, sandstone, and shale. They contain some gypsum. Slope is 0 to 2 percent. Elevation is 3,900 to 4,200 feet. The average annual precipitation is about 13 to 14 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 185 to 205 days.

Typical pedon of Tucumcari clay loam, 0 to 2 percent slopes; 0.12 mile east and 0.14 mile north of the intersection of two roads, in sec. 8, T. 9 S., R. 29 E.

- A11—0 to 3 inches; reddish brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; moderate fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine roots and few fine roots; common very fine pores and few fine pores; slightly effervescent; moderately alkaline; clear smooth boundary.
- A12—3 to 8 inches; yellowish red (5YR 4/6) clay loam, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure; hard, firm, slightly sticky and plastic; common very fine roots and few fine roots; common very fine pores and few fine pores; strongly effervescent; moderately alkaline; clear wavy boundary.
- B21t—8 to 11 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; strong medium subangular blocky structure; very hard, firm, slightly sticky and plastic; common very fine roots and few fine roots; common fine pores and few fine pores; thin patchy clay films on faces of peds and in pores; strongly effervescent; moderately alkaline; clear wavy boundary.
- B22t—11 to 33 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; strong coarse subangular blocky structure parting to medium subangular blocky; extremely hard, extremely firm, sticky and plastic; few very fine roots; few very fine pores; thin nearly continuous clay films on faces of peds and in pores; strongly effervescent; moderately alkaline; clear wavy boundary.
- C1—33 to 50 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; massive; extremely hard, very firm, sticky and plastic; common fine soft masses of gypsum; violently effervescent; strongly alkaline; gradual wavy boundary.
- C2—50 to 60 inches; red (2.5YR 5/6) clay, yellowish red (5YR 4/6) moist; massive; very hard, firm, sticky and

plastic; many fine soft masses of gypsum; violently effervescent; moderately alkaline.

The solum ranges from 30 to 48 inches in thickness. It is less than 15 percent calcium carbonate. Some pedons do not have fine masses of gypsum crystals in the C horizon. Some pedons have a few fragments of shale and sandstone.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 or 4. It is loam or clay loam.

The Bt horizon has hue of 2.5YR or 5YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 to 6. It is clay loam, silty clay loam, or clay.

The C horizon has hue of 2.5YR or 5YR, value of 4 to 6 when dry and 3 to 5 when moist, and chroma of 4 to 6. It is clay loam, silty clay loam, or clay.

Upton Series

The soils in the Upton series are classified as Typic Paleorthids, loamy, carbonatic, thermic, shallow. These shallow, well drained, moderately permeable soils are on knolls and ridges of terraces and uplands. The soils formed in calcareous alluvial and eolian deposits. Slope is 0 to 5 percent. Elevation is 3,600 to 4,300 feet. The average annual precipitation is 11 to 12 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 200 to 210 days.

Typical pedon of Upton gravelly loam, 0 to 5 percent slopes; 81 feet north of road and 0.1 mile east of windmill, in the SE1/4SW1/4 of sec. 3, T. 10 S., R. 21 E.

- A1—0 to 4 inches; brown (10YR 5/3) gravelly loam, dark brown (10YR 4/3) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and common fine roots; common very fine pores; 15 percent gravel and 5 percent cobbles; slightly effervescent; moderately alkaline; gradual smooth boundary.
- B2—4 to 9 inches; yellowish brown (10YR 5/4) gravelly loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; slightly sticky and slightly plastic; common very fine roots; common very fine pores; 20 percent cobbles and 15 percent gravel; strongly effervescent; moderately alkaline; abrupt smooth boundary.
- C1cam—9 to 15 inches; white (10YR 8/2) caliche; indurated in the upper 2 inches and strongly cemented below.

Depth to the petrocalcic horizon is 7 to 20 inches. The solum is 20 to 35 percent rock fragments, mainly limestone or caliche pebbles.

The A1 horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 to 4.

The B2 horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 to 4. It is gravelly loam or cobbly loam.

The Ccam horizon has hue of 7.5YR or 10YR, and it has chroma of 0 to 3. It is an indurated layer, although in some pedons the surface is fractured.

Ustifluvents

Ustifluvents are deep, somewhat poorly drained, slowly permeable to moderately permeable, frequently flooded soils on the flood plain of the Pecos River. The soils formed in alluvium. Slope is 0 to 2 percent. Elevation is 3,500 to 3,700 feet. The average annual precipitation is 11 to 12 inches. The average annual air temperature is 59 to 61 degrees F, and the average frost-free period is 200 to 210 days.

Reference pedon of Ustifluvents, frequently flooded, nearly level; 2,112 feet west and 1,584 feet south of the northeast corner of sec. 20, T. 7 S., R. 26 E.

- A11—0 to 3 inches; brown (7.5YR 4/4) loam, dark brown (7.5YR 3/4) moist; moderate fine platy structure; soft, very friable, slightly plastic; many very fine and fine roots; strongly effervescent; moderately alkaline; clear smooth boundary.
- A12—3 to 12 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 3/4) moist; moderate fine platy structure; soft, very friable, slightly plastic; common very fine and fine roots; common fine soft masses of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.
- A13—12 to 18 inches; light brown (7.5YR 6/4) very fine sandy loam, brown (7.5YR 4/4) moist; massive; soft, very friable; common very fine and fine roots; strongly effervescent; moderately alkaline; abrupt smooth boundary.
- C1—18 to 22 inches; brown (7.5YR 5/4) silty clay, dark brown (7.5YR 3/4) moist; moderate very fine platy structure; hard, firm, sticky and plastic; common fine and very fine roots; common fine soft masses of calcium carbonate; strongly effervescent; moderately alkaline; abrupt smooth boundary.
- C2—22 to 25 inches; strong brown (7.5YR 5/6) very fine sandy loam, strong brown (7.5YR 4/6) moist; massive; soft, very friable; common fine roots; strongly effervescent; moderately alkaline; abrupt smooth boundary.
- C3—25 to 30 inches; brown (7.5YR 5/4) silt loam, dark brown (7.5YR 3/4) moist; weak fine platy structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; strongly effervescent; moderately alkaline; clear smooth boundary.
- C4—30 to 38 inches; strong brown (7.5YR 5/6) very fine sandy loam, strong brown (7.5YR 4/6) moist; massive; soft, very friable; common fine roots; strongly effervescent; moderately alkaline; abrupt smooth boundary.

C5—38 to 42 inches; light brown (7.5YR 6/4) loamy fine sand, brown (7.5YR 4/4) moist; massive; soft, very friable; common fine roots; common fine soft masses of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

C6—42 to 48 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 3/4) moist; moderate fine platy structure; hard, firm, sticky and plastic; common fine roots; strongly effervescent; moderately alkaline; abrupt smooth boundary.

C7—48 to 52 inches; strong brown (7.5YR 5/6) loamy fine sand, strong brown (7.5YR 4/6) moist; massive; soft, very friable; few fine roots; strongly effervescent; moderately alkaline; abrupt smooth boundary.

C8—52 to 60 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 3/4) moist; massive; hard, firm, sticky and plastic; few fine roots; strongly effervescent; moderately alkaline.

These soils are highly variable. The C horizon is highly stratified. It ranges from loamy fine sand to silty clay.

Yturbide Series

The soils in the Yturbide series are classified as Typic Torripsamments, mixed, thermic. These deep, excessively drained, rapidly permeable soils are on terrace fronts adjacent to flood plains. The soils formed in alluvium. Slope is 7 to 13 percent. Elevation is 3,700 to 3,800 feet. The average annual precipitation is 11 to 12 inches. The average annual air temperature is 59 to 61 degrees F, and the frost-free season is 200 to 210 days.

Typical pedon of Yturbide loamy sand, 7 to 13 percent slopes; 1,584 feet north and 400 feet west of the southeast corner of sec. 18, T. 7 S., R. 26 E.

- A1—0 to 20 inches; brown (7.5YR 5/4) loamy sand, brown (7.5YR 4/4) moist; massive; soft, very friable; common very fine and few medium roots; 9 percent gravel; common very fine pores; strongly effervescent; moderately alkaline; clear wavy boundary.
- C1—20 to 31 inches; light reddish brown (5YR 6/4) gravelly loamy sand, reddish brown (5YR 5/4) moist; massive; soft, very friable, slightly sticky and slightly plastic; common very fine and few medium roots; 30 percent gravel; common very fine and few fine pores; few soft masses of calcium carbonate; violently effervescent; moderately alkaline; clear abrupt boundary.
- C2—31 to 37 inches; light reddish brown (5YR 6/4) sand, reddish brown (5YR 5/4) moist; massive; soft, very friable; few very fine roots; 3 percent gravel; common very fine and few fine pores; slightly

effervescent; moderately alkaline; clear wavy boundary.

C3—37 to 42 inches; light reddish brown (5YR 6/4) gravelly sand, reddish brown (5YR 5/4) moist; massive; slightly hard, very friable; few very fine roots; 34 percent gravel; common very fine pores; strongly effervescent; moderately alkaline; clear wavy boundary.

C4—42 to 53 inches; pink (5YR 7/4) sand, light reddish brown (5YR 6/4) moist; massive; soft, very friable;

few very fine roots; 4 percent gravel; common very fine pores; slightly effervescent; mildly alkaline; clear wavy boundary.

C5—53 to 60 inches; light reddish brown (5YR 6/4) sand, reddish brown (5YR 5/4) moist; massive; soft, very friable; slightly effervescent; moderately alkaline.

The weighted average content of rock fragments in the control section ranges from 15 to 20 percent.

Factors of Soil Formation

Soil is a natural body on the surface of the earth in which plants grow. It consists of organic and mineral material and is the result of the interaction of the genetic and environmental factors of parent material, climate, plant and animal life, relief, and time. These factors produce many kinds of soil that differ in their appearance, composition, productivity, and management requirements.

The characteristics of a soil are determined by the physical and mineralogical composition of the parent material; the climate under which the soil material accumulated and has existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time these factors have been active.

Climate and plant and animal life are the active factors in soil formation. They act on the parent material that has accumulated through the weathering of rock, and they slowly change it into a soil with genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent material also affects the kind of profile that can be formed and, in some cases, determines it almost entirely. Finally, time is needed for the development of distinct horizons.

The factors of soil formation are so closely interrelated that few generalizations can be made. Each factor, as it occurs in the survey area, is described in the pages that follow.

Parent Material

Parent material to a large degree determines the texture, structure, color, fertility, mineralogy, and chemical composition of a soil. Geologic formations of Permian, Triassic, Tertiary, and Quaternary age are the source of the parent material of the soils in this survey area (3, 5, 6, 7, 8).

The soils in the extreme eastern part of the area formed in alluvial and eolian sediment of Pleistocene age and are underlain by the Tertiary Ogallala Formation, which characteristically has an indurated caliche cap. The Douro, Faskin, Kimbrough, Ratliff, Sharvana, and Slaughter soils formed in this sediment. The Kimbrough, Sharvana, and Slaughter soils are shallow to the indurated caliche, and the Douro, Faskin, and Ratliff soils are moderately deep and deep. Thick, sandy eolian deposits of Quaternary age also are in this part of the

area. Nutivoli and Jalmar soils are associated with these deposits.

The east-central part of the area is dominated by sandy eolian and loamy alluvial sediment of Quaternary age. This material is calcareous. The Bluepoint and Roswell soils in this part of the area are deep fine sands and loamy fine sands. The Chispa, Stromal, and Malstrom soils have a highly calcareous, loamy substratum. The Berino, Faskin, and Jalmar soils have a well developed sandy clay loam subsoil.

In the northeastern part of the survey area, along Hernandez Draw and along the western edge of the east-central part of the area, the soils have been influenced by Triassic rock. The Latom soils in this part of the area formed in residuum derived from sandstone. The Tucumcari soils formed in old, moderately fine textured alluvium and have a clayey, calcareous subsoil. The Redona and Canez soils formed in old, medium textured alluvium. Carbonates have been leached in these soils, and the soils have a well developed sandy clay loam subsoil.

Recent alluvium is on the flood plains of the Pecos River, Salt Creek, Macho Draw, and other tributaries of the Pecos watershed. The Bigetty and Glendale soils formed in medium textured and moderately fine textured material. The Pecos soils formed in saline, fine textured sediment, and the Harkey soils formed in loamy, calcareous material.

The soils in the vicinity of Roswell formed in loamy and moderately fine textured sediment that is of Quaternary and Tertiary age and is derived mainly from limestone. The Upton soils that are shallow over indurated caliche and the deep, calcareous Reakor soils formed in this sediment.

The central part of the area, west of the Pecos River, and a band extending along the eastern side of the Pecos River are dominated by soils influenced by red siltstone, shale, and white gypsum sediment of Permian age. Deep, calcareous, medium textured and moderately fine textured soils that formed in old alluvium derived from this sediment are those of the Alama and Poquita series. The Milner and Reeves soils are shallow and moderately deep, and they formed in calcareous alluvium over gypsum sediment. The Hollomex soils formed in thin alluvium and residuum derived from gypsum sediment.

The western part of the survey area is dominated by the Permian San Andres Formation, which consists of fine-grained limestone. The shallow Deama and Ector soils formed in residual material derived from this limestone. Within this area are fans, terraces, and flood plains that are covered by alluvial sediment derived mainly from limestone. The Gabaldon soils formed in recent, calcareous, medium textured and moderately fine textured alluvium in the main drainageways of the area. The Hogadero and Pena soils formed in gravelly material on older terraces. The Asparas, Conger, Darvey, Pastura, Ranstein, Reagan, and Threadgill soils formed in medium textured and moderately fine textured alluvium derived from limestone. The Conger and Pastura soils are shallow over indurated caliche. The other soils in this part of the survey area are deep.

Climate

The survey area has a semiarid climate. This climate is characterized by abundant sunshine, low relative humidity, erratic rainfall, strong winds, and a wide variation in daily and seasonal temperatures. Winters are short and mild, and summers are long and hot. The soils rarely freeze to a depth of more than a few inches. March is the windiest month. Soils associated with the older Quaternary landscapes, more than 10,000 years old, were influenced by climates somewhat cooler and more humid than the present climate.

Climate has a direct influence on soil formation and is one of the more important factors in the survey area. Temperature and precipitation affect the amounts and kinds of vegetation that grows. Organic matter decomposes more rapidly in warm climates. Precipitation affects the amount of leaching and the movement of clay in soils. Warmer temperatures and higher precipitation cause more rapid weathering of parent material than do cooler temperatures and lower precipitation. Strong winds influence the formation of some soils.

The relatively low precipitation and its distribution and the relatively high temperatures in the area promote the dominance of grassland vegetation. The soils at lower elevations receive less precipitation and are warmer than those at higher elevations. The organic matter content of the soils increases as precipitation increases or temperature decreases, or both. The Reakor and Darvey soils formed in similar parent material and on similar landscapes, but the Reakor soils contain less organic matter than the cooler and more moist Darvey soils.

In soils that have high available water capacity, the total precipitation has not been sufficient to completely wet and leach them. In the Reakor and similar soils, partial leaching of calcium carbonate has taken place in the upper part of the profile and calcium carbonate has accumulated at the normal depth of wetting. In some areas of sandy soils, the total precipitation exceeds the

available water capacity of the soils to the extent that there has been leaching of the calcium carbonate. Examples of these soils are those of the Roswell and Pyote series. Some soils have formed over a sufficiently long period of time that there have been both leaching of carbonates and translocation of clay minerals. The Canez soils, which are characterized by an accumulation of clay in the subsoil and the absence of calcium carbonate, are an example.

Wind has had a strong influence on soil formation in the area, especially in the eastern part. Strong winds have eroded or partially eroded the surface layer of many of the soils in the area. Sandy material has been redeposited in areas of lower wind velocity, and in some areas the material has been reworked into dunes. The Roswell soils are an example of soils that formed on dunes. In areas that are subject to overgrazing by livestock, removal or partial removal of the surface layer by wind and deposition of the soil material on adjacent soils influence the use, management, and future development of these soils.

Living Organisms

Plants, micro-organisms, earthworms, and other forms of life on or in the soil are active in soil formation. They provide organic matter, help decompose plant residue, affect the chemistry of the soils, and hasten soil development. Living soil organisms also help convert plant nutrients into a form that is available to higher plants. Some organisms retard horizon differentiation by churning or mixing the soil.

Of the living organisms in the survey area, vegetation has had the greatest influence. The original vegetation was mainly grasses. Grasses draw moisture and mineral nutrients from the soil, and penetration of the soil by their roots greatly influences aeration and soil permeability. Residue is returned to the soil to replenish the supply of organic matter. Grasses contribute considerable quantities of organic material to the surface layer and protect the soil from loss of water because of runoff, from water erosion, and from soil blowing. They also keep the soil supplied with plant nutrients by recycling them from a greater depth to the surface.

The grass species in the area and their production vary and are related to the climate and soil. Deep, sandy soils and soils on the flood plains are dominated by mid and tall grasses. Short and mid grasses are on alluvial slopes, fans, and terraces. Shrubs are most common on shallow and gravelly soils and along drainageways.

Where the annual precipitation is about 12 inches and the elevation is below 4,000 feet, the production of grasses is relatively low. The high air temperatures and low humidity in these areas reduce the effectiveness of the precipitation. The accumulation of organic matter is low because of this combination of factors and high soil temperatures.

Reakor soils are an example of soils that have low organic matter content. Because of this, the loamy surface layer exhibits poor aggregation, generally has a crust, and easily becomes puddled. This soil condition retards the infiltration of water and increases runoff.

Production of grasses increases along with increases in precipitation, higher elevation, and cooler temperatures, which increases the accumulation of organic matter in the soils. Reagan and Darvey soils are examples of soils that support more grass production than the Reakor soils and thus have a higher organic matter content.

Relief

Relief, shape, and slope of the landscape influence soil formation, mostly because of their effect on drainage, plant cover, soil temperature, surface runoff, and erosion. Changes in relief in the survey area are relatively subtle. The effect of slope on runoff has had the greatest influence on the general relief in this area.

Runoff is greater on sloping soils, which are subject to a greater hazard of erosion. As a result of less water entering the soil, less organic matter is produced and less development takes place within the soil profile. Soils in swales or other concave areas receive more moisture in the form of runoff. This additional moisture enters the profile and increases grass production, which increases the organic matter content of the surface layer and the development of the profile. The Asparas and Ranstein soils, for example, are soils that have more organic matter and exhibit greater development than the adjacent sloping Threadgill and Hodgins soils because they receive runoff.

Eroded soil material is redeposited along flood plains and drainageways, which increases the thickness of the surface layer in these areas. Because of this and the increased amount of moisture available for vegetation, the added growth of vegetation increases the organic matter content of the soils. The low-lying Bigetty and Gabaldon soils, which have a thick, dark-colored surface layer, are examples of soils that formed in this area.

Exposure has little effect on soil formation in this survey area. In general, the north-facing slopes are cooler than the south-facing slopes; however, the effects of exposure are more pronounced in regions where the climate is more temperate than that of the area.

Time

The length of time required for the formation of a given kind of soil depends largely upon the other factors of soil formation. An estimate of the age, or maturity, of a soil is based on the kinds, the thickness, and the arrangement of genetic horizons. Generally, the greater the number of genetic horizons, the more mature the soil.

Tucumcari soils provide a good example of the interaction of the soil forming processes. These soils formed in fine textured alluvium of Triassic age. There has been some accumulation of organic matter in the surface layer. Water percolating through the soil profile has weathered clay-forming minerals and has translocated the clay into the subsoil. Calcium carbonate has been leached downward.

Glendale and Harkey soils are examples of young soils in the survey area. They have formed in recent alluvium, have low organic matter content, and do not exhibit subsoil development.

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Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvial fan. The fanlike deposit of a stream where it issues from a gorge upon a plain or of a tributary stream near or at its junction with its main stream.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils 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—

| | <i>Inches</i> |
|----------------|---------------|
| Very low..... | 0 to 3 |
| Low..... | 3 to 6 |
| Moderate..... | 6 to 9 |
| High..... | 9 to 12 |
| Very high..... | More than 12 |

Back slope. The geomorphic component that forms the steepest inclined surface and principal element of many hillsides. Back slopes in profile are commonly steep, are linear, and may or may not include cliff segments.

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 wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil 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 are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—
Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a “wire” when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coppice dune. A small mound of stabilized soil material around desert shrubs.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

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 arresting grazing for a prescribed period.

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 periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature; for example, fire that exposes the surface.

Excess alkali (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

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.

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not

prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

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 upper case letter represents the major horizons. Numbers or lower case 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 at the surface of a mineral soil.

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.

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. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

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 A or B horizon. 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, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hummocky. Refers to a landscape of hillocks, separated by low sags, having sharply rounded tops and steep sides. Hummocky relief resembles rolling

or undulating relief, but the tops of ridges are narrower and the sides are shorter and less even.

Increasesers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasesers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration 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 |

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—
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.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

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.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones (in tables). Rock fragments 3 inches (7.5 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.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to

permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

| | |
|-----------------------|------------------------|
| Very slow..... | less than 0.06 inch |
| Slow..... | 0.06 to 0.20 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 |

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.

Pitting (in tables). Pits caused by melting ground ice. They form on the soil after plant cover is removed.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

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.

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 condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

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 degree of acidity or alkalinity is expressed as—

| | <i>pH</i> |
|-----------------------------|----------------|
| Extremely acid..... | Below 4.5 |
| Very strongly acid..... | 4.5 to 5.0 |
| Strongly acid..... | 5.1 to 5.5 |
| Medium acid..... | 5.6 to 6.0 |
| Slightly acid..... | 6.1 to 6.5 |
| Neutral..... | 6.6 to 7.3 |
| Mildly 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 |

Redbed (geology). Sedimentary strata largely of Permian and Thassic age, that are predominantly red in color. Redbeds contain few fossils.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

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.

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-size particles.

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 or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Sinkhole. A depression in the landscape where limestone has been dissolved.

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.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

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 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

| | <i>Millimeters</i> |
|-----------------------|--------------------|
| 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 and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

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."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace (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 too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

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.

