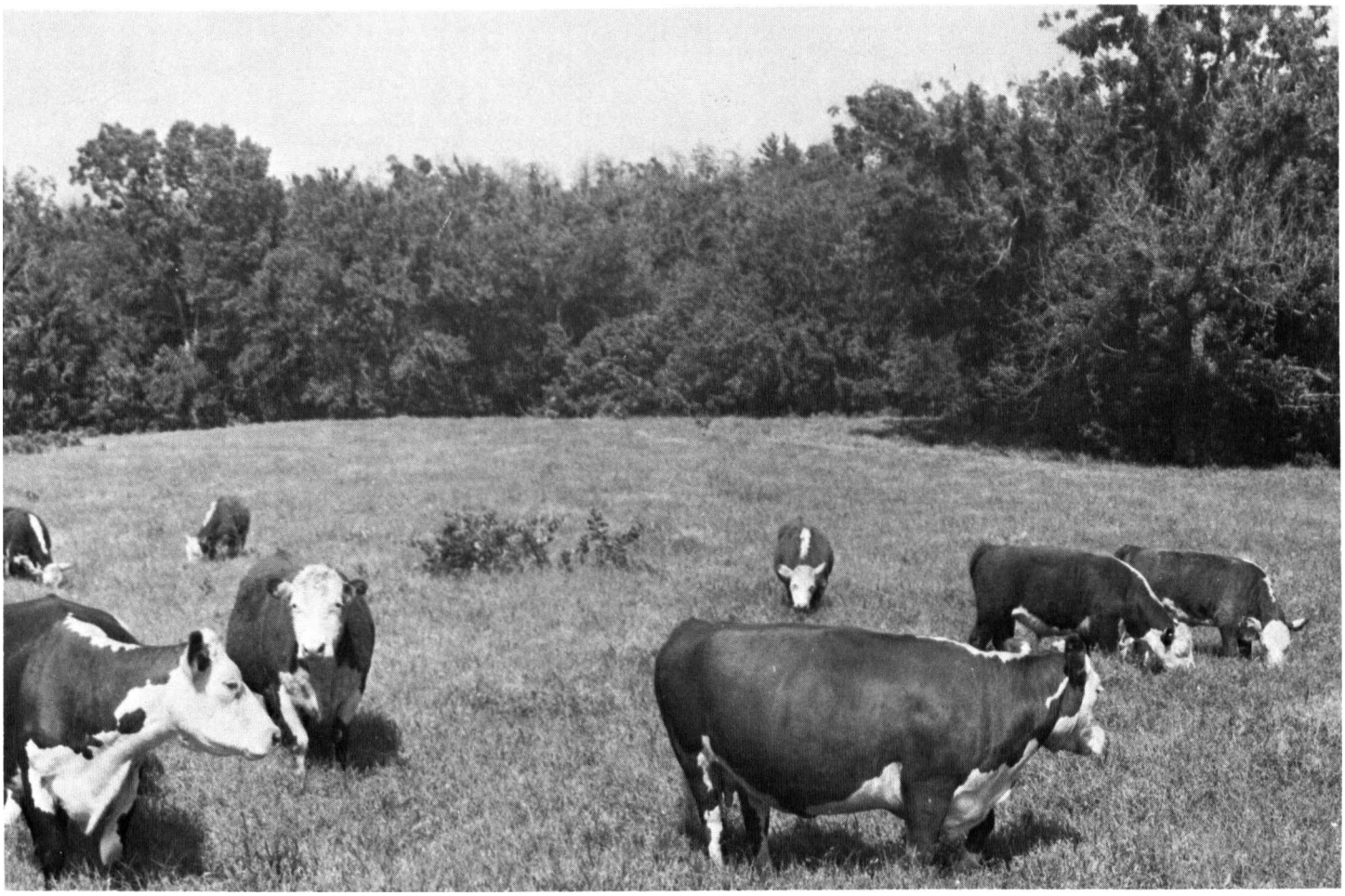
SOIL SURVEY OF

Osage County, Oklahoma

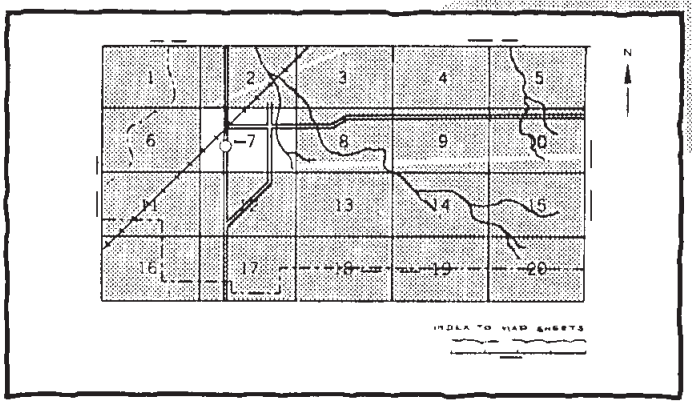


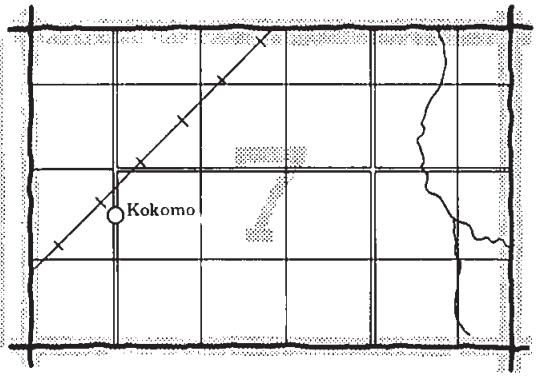
United States Department of Agriculture
Soil Conservation Service
and
United States Department of the Interior
Bureau of Indian Affairs

In cooperation with
Oklahoma Agricultural Experiment Station

HOW TO USE

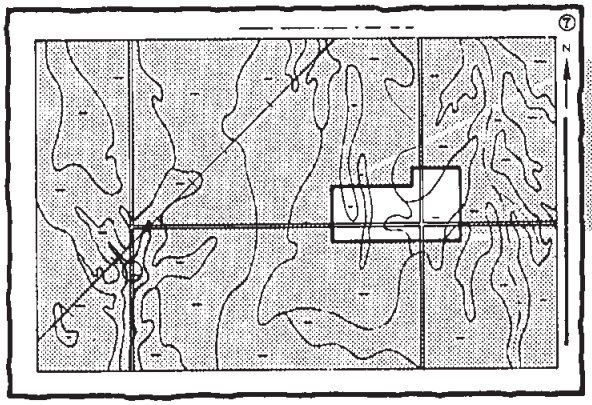
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

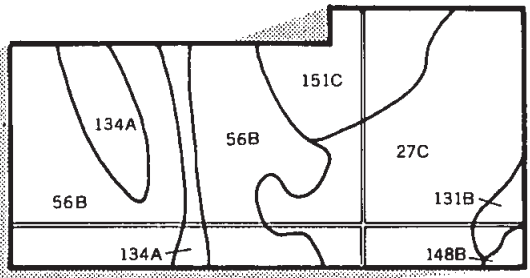




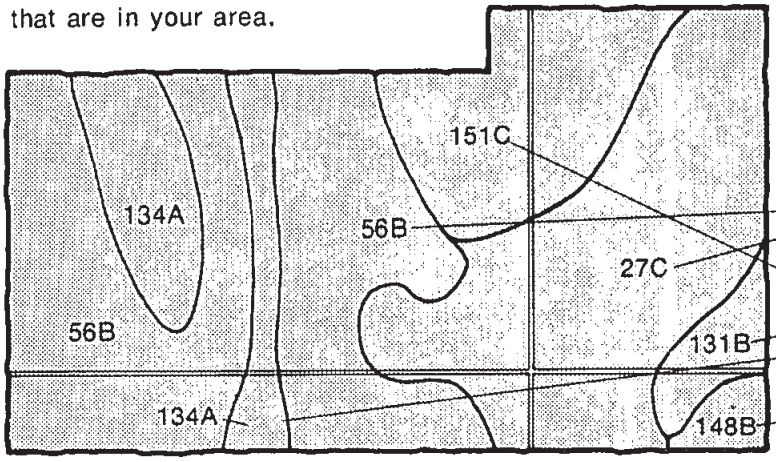
2. Note the number of the map sheet and turn to that sheet.

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





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

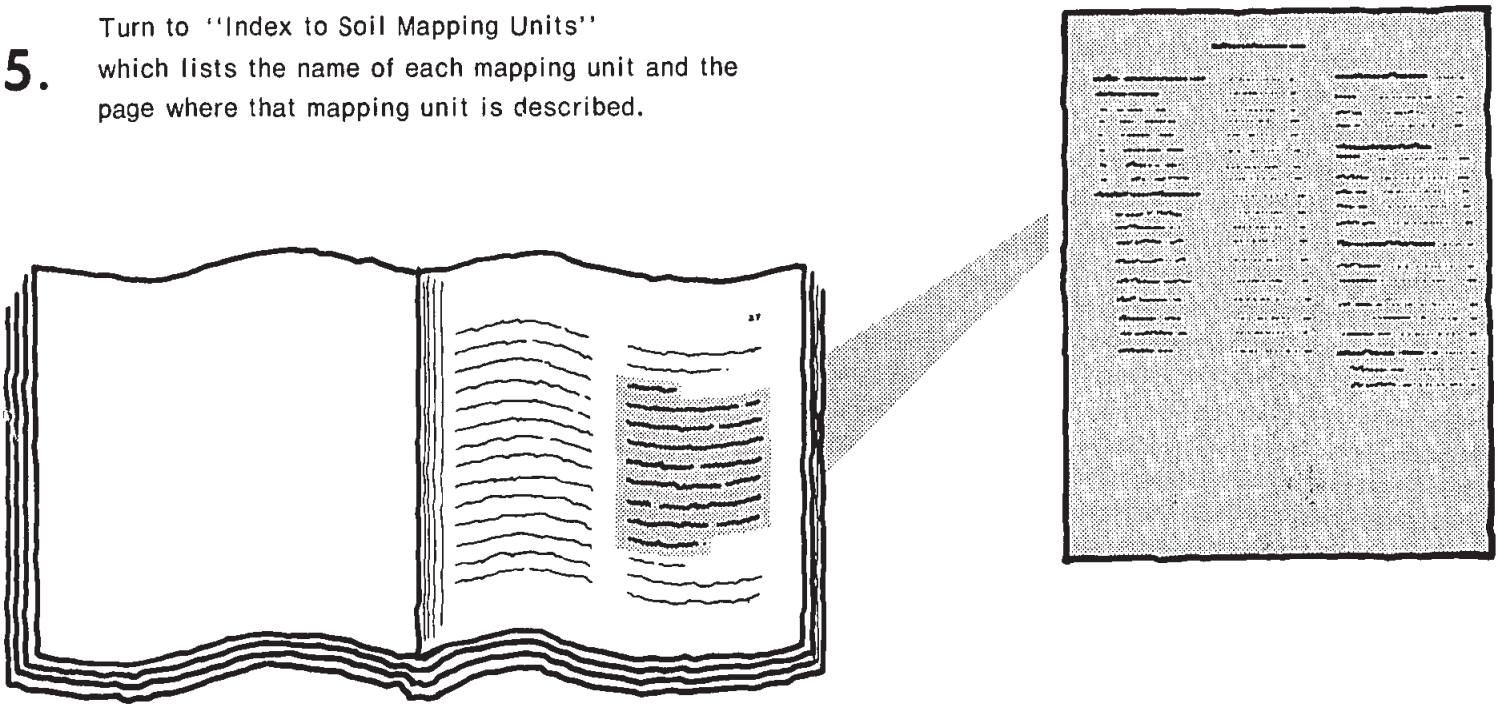


Symbols

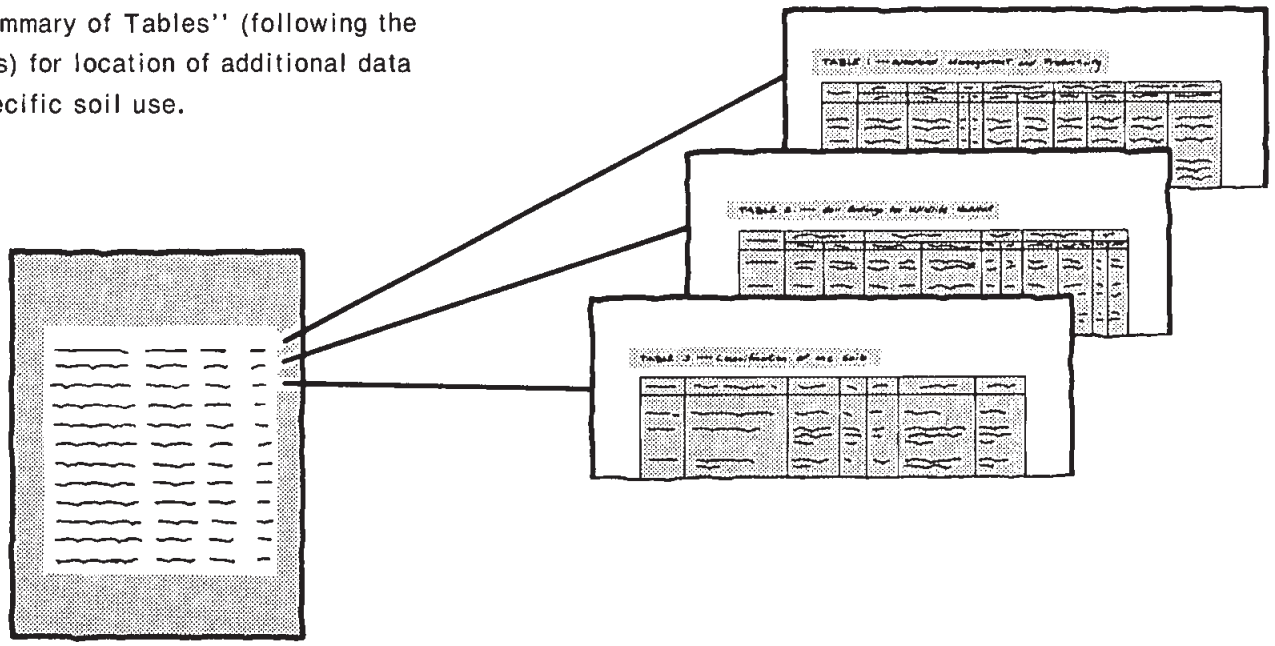
27C
56B
131B
134A
148B
151C

THIS SOIL SURVEY

5. Turn to "Index to Soil Mapping Units" which lists the name of each mapping unit and the page where that mapping 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; for specialists in wildlife management, waste disposal, or pollution control.

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. 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 completed in the period 1960-1973. Soil names and descriptions were approved in 1975. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1975. This survey was made cooperatively by the Soil Conservation Service, Bureau of Indian Affairs, and the Oklahoma Agricultural Experiment Station. It is part of the technical assistance furnished to the Osage County Conservation District.

Soil maps in this survey may be copied without permission, but any enlargement of these maps could cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

Cover.—Cattle grazing bermudagrass overseeded with lespedeza. The soil is Bates loam, 1 to 3 percent slopes.

Contents

Issued April 1979

Index to soil mapping units

Summary of Tables

Summary of Tables—Continued

Foreword

The Soil Survey of Osage County contains much information useful in any land-planning program. Of prime importance are the predictions of soil behavior for selected land uses. Also highlighted are limitations or hazards to land uses that are inherent in the soil, improvements needed to overcome these limitations, and the impact that selected land uses will have on the environment.

This soil survey has been prepared for many different users. Farmers, ranchers, foresters, and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, developers, builders, and homebuyers can use it to plan land use, select sites for construction, develop soil resources, or identify any special practices that may be needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the soil survey to help them understand, protect, and enhance the environment.

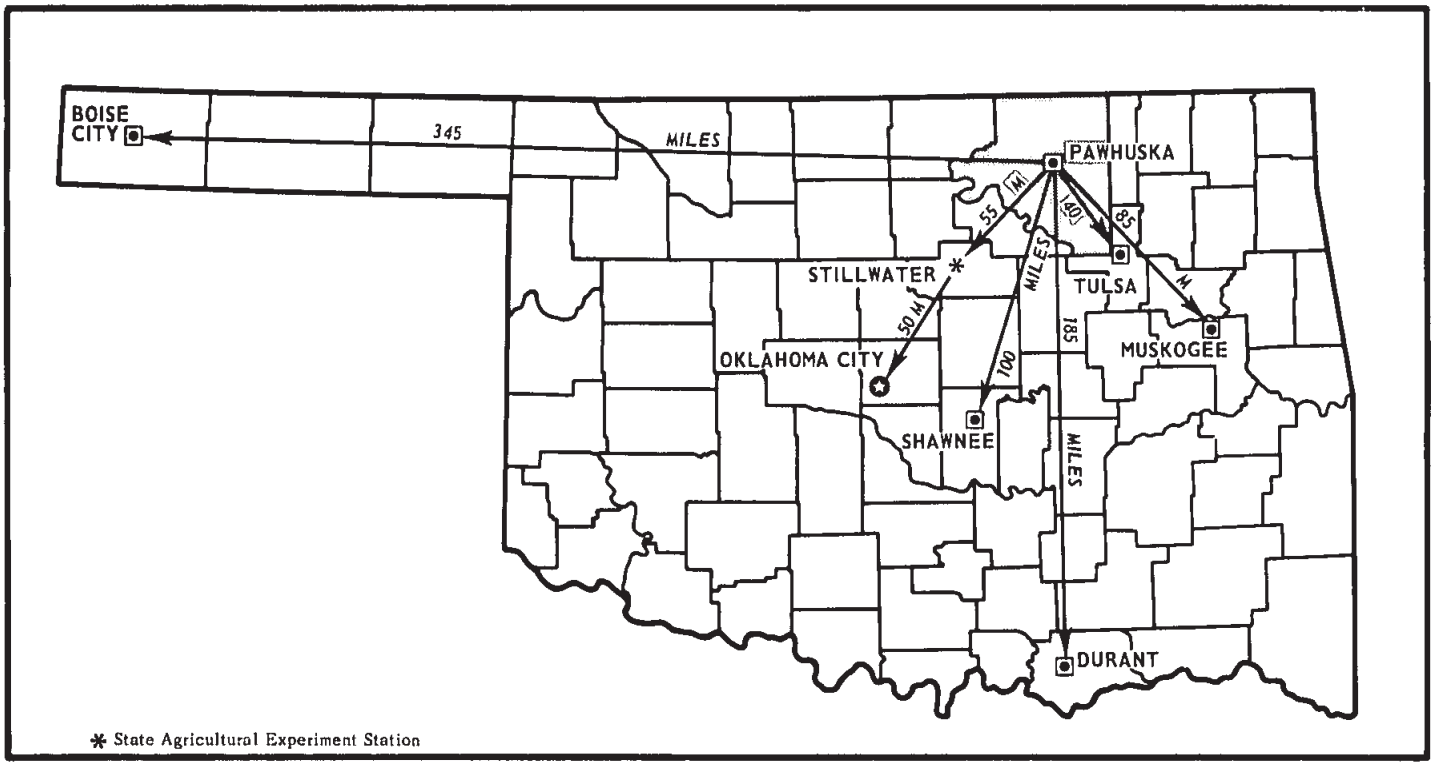
Many people assume that soils are all more or less alike. They are unaware that great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be shallow to bedrock. They may be too unstable to be used as a foundation for buildings or roads. Very clayey or wet soils are poorly suited to 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 kind of soil is shown on detailed soil maps. Each kind of soil in the survey area is described, and much information is given about each soil for specific uses. Additional information or assistance in using this publication can be obtained from the local office of the Soil Conservation Service, Bureau of Indian Affairs, or the Cooperative Extension Service.

We believe that this soil survey can help bring us a better environment and a better life. Its widespread use can greatly assist us in the conservation, development, and productive use of our soil, water, and other resources.

Roland R. Willis

State Conservationist
Soil Conservation Service



.—Location of Osage County in Oklahoma.

SOIL SURVEY OF OSAGE COUNTY, OKLAHOMA

By Bobby G. Bourlier, Joe D. Nichols, and William J. Ringwald, Soil Conservation Service, and by P.J. Workman and Stanley Clemmons, Bureau of Indian Affairs

United States Department of Agriculture, Soil Conservation Service, and United States Department of Interior, Bureau of Indian Affairs, in cooperation with the Oklahoma Agricultural Experiment Station

Osage County, in the northeastern part of Oklahoma, borders Kansas (see facing page). It is the largest county in the State, with total area of 1,476,480 acres. Pawhuska, which means "white hair," is near the center of the county.

General Nature of the County

The Osage Indians were the first settlers in Osage County. In 1907, the tribe alloted 658 acres to each individual listed on the tribal roll. Most of the 2,229 Indians chose to live on the most suitable land for farming. They grew mainly corn and maize and hunted buffalo and prairie chicken for meat. The rolling grasslands and woodlands were leased out to later settlers, who put together many large ranches, several of which have been held together by purchase and lease since that time.

The first immigrants entering the reservation were allowed to live only in three unalloted and unrestricted townsites: Pawhuska, Hominy, and Greyhorse. Most were government employees working as agents, clerks, teachers, mechanics, and traders. After Oklahoma attained statehood in 1907, many settlers were able to purchase land from the Indians and cattle from the herds passing northward through the county to market.

Most of the flood plains along the Arkansas River and other major streams were cleared of trees and brush between 1910 and 1930. The deeper soils on the uplands were also plowed, and vast acreages of corn, oats, and wheat were grown. The Depression and the Dust Bowl of the 1930's forced many farmers to abandon their land. Much of it was sold to the larger cattle ranches or taken over by the banks that held the mortgages. The fields lay idle for many years, and many of the soils of the uplands became severely eroded.

During the early 1940's, bermudagrass was brought into the county through efforts of the Osage County Conservation District and the Soil Conservation Service to help control erosion and to provide additional grazing land. The early plantings thrived and grew beyond expectations, and demand for root stock far exceeded availability. Since then about 112,600 acres, or about 6 percent of the county, has been planted to tame pasture plants.

Before 1960, much of the range was grazed by steers brought in from southern states by rail only during the growing season. After a season of grazing on the tall prairie grasses, these steers were shipped on to northern markets. The Blackland shipping pens, in the north-central part of the county along the now-abandoned Midland Valley Railroad, was once the main shipping and receiving point for cattle moving in and out of Osage. Since 1960, many of the ranchers have incorporated cow-calf operations with their steer grazing program, making a balanced year-round business.

Ranches grew steadily in size from the establishment of statehood through the late 1960's; many ranches are 15,000 to 20,000 acres, and a few are 80,000 to 100,000 acres. Inflation set in, cattle markets declined, and many ranches have been subdivided, sold, or leased out, but a few are still expanding.

Ranching is the main enterprise in Osage County. The average operating unit is about 1,035 acres. About 75 percent of the land in farms or ranches is open range, 12 percent is wooded range, 7 percent is cropland, and 6 percent is tame pasture.

Small grains, mainly wheat, alfalfa, grain sorghums, and soybeans are the principal crops. Corn and sorghums cut for silage, and orchard crops are grown on a minor acreage.

Local dairies use most of the corn and sorghums and much of the alfalfa hay produced in the country. A large acreage of native grasses and tame pastures are cut for hay; much of this is used by local farmers and ranchers. The other crops are shipped to local and distant markets and sold for cash.

Climate

The consistent pattern of climate in Osage County is one of cold winters and long, hot summers. Heavy rains occur mainly in spring and early in summer, when moist air from the Gulf of Mexico interacts with drier continen-

tal air. The annual rainfall is normally adequate for corn, soybeans, and all grain crops.

Table 1 gives data on temperature and precipitation for the survey area. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season. All data was recorded at Pawhuska, Oklahoma, in the period 1951 to 1974.

In winter the average temperature is 38 degrees F, and the average daily minimum is 26 degrees. The lowest temperature on record, -13 degrees, occurred at Pawhuska on December 23, 1963. In summer the average temperature is 80 degrees, and the average daily maximum is 92 degrees. The highest temperature, 114 degrees, was recorded on July 14, 1954.

Growing degree days, shown in table 1, are equivalent to "heat units." Beginning in spring, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

Of the total annual precipitation, 23 inches, or 66 percent, usually falls during the period April through September, which includes the growing season for most crops. Two years in 10, the April-September rainfall is less than 18 inches. The heaviest 1-day rainfall during the period of record was 6.04 inches at Pawhuska on August 15, 1974. Thunderstorms number about 53 each year; 22 occur in summer.

Average seasonal snowfall is 10 inches. The greatest snow depth at any one time during the period of record was 13 inches. On the average, 3 days have 1 inch of snow on the ground, but the number of days varies greatly from year to year.

The average relative humidity in midafternoon is about 55 percent. Humidity is higher at night in all seasons, and the average at dawn is about 80 percent. The percentage of possible sunshine is 70 percent in summer and 55 percent in winter. Prevailing winds are southwesterly. Average windspeed is highest, 13 miles per hour, in March.

Tornadoes and severe thunderstorms occur occasionally but are local and of short duration. Damage varies and is spotty. Hailstorms occur at times during the warmer part of the year but in an irregular pattern and in only small areas.

Natural Resources

Soil is the most important natural resource in the county. It supports and produces grasses that livestock graze, crops that are produced on the farms, and trees that are used for fuel and shelter.

Farm ponds, streams, and lakes are abundant in the county; they supply most of the water for domestic and livestock uses. The underground water supply is adequate in most areas, but it is not suitable for domestic use in many localities because the water-bearing strata have been contaminated by the water flooding injection system used in the oil fields. Underground water suitable for irrigation is sufficient along the Arkansas River. Several small lakes provide adequate water storage for irrigating cropland and pasture.

Oil and gas production are also major natural resources in the county. The first well of significance was drilled by Edwin Foster of the Phoenix Oil Company in June 1897, near the eastern boundary of the county. It was drilled to a depth of 1,349 feet into a sand strata now known as the "Bartlesville Sand." Within 6 years, 30 more wells had been drilled, and by 1920 the Burbank field had been discovered; the oil boom was well on its way. Today, more than 25,000 oil and gas wells, owned by more than 1,000 oil companies, produce about 10 percent of the oil recovered in Oklahoma.

Limestone bedrock is quarried (fig. 1) near Pawhuska, Burbank, and Hominy and crushed into stones for riprap or gravel for concrete and road construction. Agricultural lime is also produced at the Pawhuska quarry.

Sand is dredged from the Arkansas River near Ralston and Ponca City.

Recreation (fig. 2) is rapidly becoming a major resource in the county, primarily because the soils, topography, and vegetation are well suited to this use. More than 30,000 surface acres of water are impounded in lakes, reservoirs, and farm ponds. Keystone Lake on the Arkansas River and Hulah Lake on the Caney River are the largest impoundments. Kaw Lake and Barnsdall Lake are presently under construction. City lakes near Pawhuska, Hominy, Fairfax, Shidler, Barnsdall, Sand Springs, and Bartlesville are available for public use at nominal fees. Sunset Lake, about midway between Pawhuska and Bartlesville, is a private recreational lake having facilities available for most users.

Osage Hills State Park in the east-central part of the county, near U.S. Highway 60, is open all year and has most popular facilities available for recreational use.

Two public hunting areas, one east of Foraker and the other on the north county line west of Elgin, Kansas, are managed primarily for prairie chicken and bobwhite quail. Other designated areas, around Keystone Lake and Hulah Lake, are open to the public for small game, big game, and waterfowl hunting. Osage County has a sizable deer population, concentrated in the scrub-oak uplands in the eastern part of the county and along the creek and river bottoms elsewhere. Wild turkeys are abundant in some areas along the wooded bottom lands.

Woolaroc Museum, on State Highway 123 between Barnsdall and Bartlesville, houses many Indian artifacts and western antiques, and the surrounding woodlands abound with exotic big game. Gilcrease Museum, in the extreme southeastern corner of the county, houses a vast display of western art and relics of the early days. The Osage County Historical Society Museum and the Osage Museum in Pawhuska house many historical Indian paintings and western relics.

Industry and Transportation

The petroleum industry in Osage County employs more people than any other industry. Most of the labor force is employed in the recovery or production of oil and gas reserves. Several hundred people, however, are engaged in research on plastics and other products made with petroleum; some produce microcrystalline waxes from petroleum. These waxes are used in making cosmetics, ointments, candles, polishes, and crayons.

Other industries in the county employ people to make clothing, carpets, bedsprings, and trolling motors.

Osage County is served by one federal highway, which crosses the county in an east-west direction near the center, and nine state highways. Three railroads serve the county.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in the survey area, where they are, and how they can be used. The soil scientists went into the area knowing they likely would locate many soils they already knew something about and perhaps identify some they had never seen before. 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; the kinds of rock; and many facts about the soils. They dug many holes to expose 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 the action of plant roots.

The soil scientists recorded the characteristics of the profiles they studied, and they compared those profiles with others in counties nearby and in places more distant. Thus, through correlation, they classified and named the soils according to nationwide, uniform procedures.

After a guide for classifying and naming the soils was worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, roads, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called soil mapping units. Some mapping units are made up of one kind of soil, others are made up of two or more kinds of soil, and a few have little or no soil material at all. Mapping units are discussed in the section "Soil Map for Detailed Planning."

While a soil survey is in progress, samples of soils are taken as needed for laboratory measurements and for engineering tests. The soils are field tested, and their interpretatons are modified as necessary during the course of the survey. New interpretations are added to meet local needs, mainly through field observations of different kinds of soil in different uses under different levels of management. Also, data are assembled from other sources, such as test results, records, field experience, and information available from state and local specialists. For example, data on crop yields under defined practices 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 is readily useful to different groups of users, among them farmers, managers of rangeland and woodland, engineers, planners, developers and builders, homebuyers, and those seeking recreation.

General Soil Map for Broad Land Use Planning

The general soil map at the back of this publication shows, in color, the soil units for broad land use planning described in this survey. Each soil unit is a unique natural landscape that has a distinct pattern of soils and of relief and drainage features. A unit typically consists of one or more soils of major extent and some soils of minor extent. It is named for the major soils. The kinds of soil in one unit can occur in other soil units, but in a different pattern.

The map provides a broad perspective of the soils and landscapes in the survey area. It provides a basis for comparing the potential of large areas for general kinds of land use. Areas that are generally suitable for certain kinds of farming or other land uses can be identified on the map. Likewise, areas of soils having properties that are distinctly unfavorable for certain land uses can be located.

Because of its small scale, the map does not show the kind of soil at a specific site. Thus, it 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 kinds of soils in any one soil unit ordinarily differ from place to place in slope, depth, stoniness, drainage, or other characteristics that affect their management.

Deep, Loamy and Sandy Soils on Wooded Flood Plains

The two associations in this group make up about 14 percent of Osage County. The soils are used mainly for field crops and tame pasture. Uncleared areas support bottom land hardwoods with an understory of native tall grasses. The soils are subject to flooding.

1. Verdigris-Mason-Wynona association

Deep, nearly level and very gently sloping, well drained to somewhat poorly drained, loamy soils

This association makes up about 12 percent of the county. Verdigris soils make up 46 percent of the association; Mason soils, 13 percent; Wynona soils, 9 percent; and minor soils, the rest. The minor soils are in the Osage, Cleora, Barnsdall, Lightning, and Drummond series. Areas of Pits and Oil-waste land are also in this association.

Verdigris soils are nearly level, moderately well drained, loamy soils commonly dissected with stream channels. They are subject to frequent or occasional flooding.

Mason soils are nearly level to very gently sloping, well drained, loamy soils on rarely flooded stream terraces.

Wynona soils are nearly level, somewhat poorly drained loamy soils that are frequently or occasionally flooded.

Osage, Lightning, and Drummond soils are minor in extent but have severe limitations for many uses. They are nearly level or slightly concave, poorly drained or somewhat poorly drained soils. They have a loamy or clayey surface layer and a clayey subsoil with high shrink-swell potential. They are rarely flooded.

Soils in this association are potentially the most fertile and productive in Osage County. They are used mainly for tame pasture, small grains, alfalfa, soybeans, and grain sorghums. A small part of the acreage is used for native hay meadows, native range, wildlife, and woodland. The potential of the soils for crops, grasses, and trees is good.

The main concerns of managing these soils are maintaining soil tilth and fertility, protecting them from flood damage, and providing surface drainage.

2. Kiomatia-Mason-Roebuck association

Deep, nearly level and very gently sloping, well drained to somewhat poorly drained, sandy and loamy soils

This association makes up 2 percent of the county. Kiomatia soils make up 35 percent of the association; Mason soils, 25 percent; Roebuck soils, 10 percent; and minor soils, the rest. Minor soils are in the Choska and Pursley series.

Kiomatia soils are somewhat excessively drained, sandy soils of low fertility. They are easily eroded by wind. Some areas are on low, undulating terraces and are frequently flooded; others are on higher, nearly level to very gently sloping terraces and are rarely flooded.

Mason soils are nearly level to very gently sloping, well drained, loamy soils on rarely flooded stream terraces.

Roebuck soils are nearly level to slightly concave, moderately well drained, occasionally flooded soils in swales and backwater areas. They have a loamy surface layer and a clayey subsoil.

Kiomatia soils are used mostly for tame pasture or native range. Mason, Roebuck, and other minor soils are used mainly for small grains, grain sorghums, cotton, alfalfa, and soybeans. Some of the acreage of this association is used for wildlife and woodland.

The potential of these soils for grasses, crops, and trees is good.

Improving or maintaining fertility, controlling soil blowing, and protecting the soils from flooding are the main concerns of managing the sandy soils on the lower terraces. Management is needed on the loamy soils on higher terraces to improve or maintain fertility and soil tilth, provide surface drainage, and protect the soils from flooding.

Deep to Shallow, Loamy Soils on Prairie Uplands

The seven associations in this group make up about 50 percent of Osage County. The soils are used mainly for native range, native hay meadows, and tame pasture. The native vegetation is mostly tall grasses interspersed with spots of short and mid grasses growing on the Carytown, Dwight, and Pawhuska soils. Soils that are free of stones and are on nearly level to gently sloping topography are suitable for cultivation. The common cultivated crops are small grains, grain sorghum, soybeans, and alfalfa.

Limestone is quarried in places.

3. Dennis-Parsons-Bates association

Deep and moderately deep, nearly level to gently sloping, loamy soils over acid sandstone or shale

This association makes up about 11 percent of the county. Dennis soils make up 28 percent of the association; Parsons soils, 14 percent; Bates soils, 11 percent; and minor soils, the rest. The minor soils are in the Carytown, Prue, Steedman, Okemah, Mason, and Verdigris series. Oil-waste land is also in this association.

Dennis soils are deep, nearly level to gently sloping, moderately well drained, loamy soils with a clayey subsoil.

Parsons soils are deep, nearly level to very gently sloping, somewhat poorly drained, loamy soils with a clayey subsoil.

Bates soils are moderately deep, very gently sloping to gently sloping, well drained, loamy soils with a loamy subsoil.

Most of the acreage is used for tame pasture and native hay meadows. Some is used for native range, and a small acreage of the soil is cultivated to small grains, grain sorghum, soybeans, and alfalfa.

The potential of these soils for crops and grasses is good. Where the soils are used for sanitary facilities, community development, and recreation, some limitations should be overcome by special design.

Maintaining soil tilth and fertility and providing protection of the soil from water erosion are the main concerns of soil management. On the Parsons and Carytown soils, additional emphasis is necessary to reduce surface crusting and control wetness.

4. Steedman-Coweta-Bates association

Moderately deep and shallow, very gently sloping to steep, loamy soils over shale and sandstone; on ridge crests and side slopes

This association makes up about 17 percent of the county. Steedman soils make up 40 percent of the association; Coweta soils, 21 percent; Bates soils, 6 percent; and minor soils, the rest. The minor soils are in the Darnell, Carytown, Niotaze, Parsons, Prue, Foraker, and Shidler series. Oil-waste land is also in this association.

Steedman soils are stony, moderately deep, moderately well drained, loamy soils with a clayey subsoil. They are on gently sloping to steep side slopes.

Coweta soils are shallow, well drained to somewhat excessively drained, loamy soils on very gently sloping to sloping ridge crests and in contour bands on side slopes.

Bates soils are moderately deep, very gently sloping to sloping, well drained, loamy soils on ridge crests and on flanks of slopes.

These soils are used mostly for native range. Some of the very gently sloping to gently sloping areas are mowed for native hay. These soils have good potential for native grasses and pasture grasses. Where the soils are used for sanitary facilities and community development, their limitations should be overcome by special design. Improving or maintaining the quality of native grasses and protecting the soils from fire are the main concerns of managing these soils.

5. Apperson-Wolco-Dwight association

Deep, nearly level and very gently sloping, loamy soils over limestone

This association makes up about 4 percent of the county. Apperson soils make up about 30 percent of the association; Wolco soils, 27 percent; Dwight soils, 22 percent; and minor soils, the rest. The minor soils are of the Summit, Lula, and Shidler series.

The Apperson, Wolco, and Lula soils are 40 to 60 inches thick over limestone. They are nearly level to very gently sloping and have a loamy surface layer.

Apperson soils are somewhat poorly drained; they have a clayey subsoil and high shrink-swell potential.

Wolco soils are moderately well drained and have a clayey subsoil.

Dwight soils are moderately well drained and have a clayey subsoil.

These soils are used mostly for native range and hay meadows, but in places these soils are cultivated to small grains, grain sorghums, soybeans, and alfalfa. A few are used for tame pasture and wildlife habitat. These soils have fair potential for crops and grasses. Where the soils are used for sanitary facilities and community development, their limitations should be overcome by special design.

The main concerns of managing these soils are maintaining fertility and soil tilth and controlling water erosion. In addition, the Dwight soils need management to reduce surface crusting, increase water intake, and overcome alkalinity.

6. Shidler-Summit-Foraker association

Very shallow to deep, very gently sloping to steep, loamy soils over limestone and limy shales; on ridge crests and side slopes

This association makes up about 10 percent of the county. Shidler soils make up about 41 percent of the association; Summit soils, 23 percent; Foraker soils, 8 percent; and minor soils, the rest. Minor soils are in the Catoosa, Apperson, Grainola, Coweta, Corbin, and Verdigris series. Pits and Oil-waste land are also in this association.

Shidler soils are very shallow, stony, very gently sloping to sloping, somewhat excessively drained soils forming from limestone.

Summit soils are deep, gently sloping to strongly sloping, somewhat poorly drained soils with high shrink-swell potential. They formed from shale.

Foraker soils are moderately deep, moderately steep to steep, somewhat poorly drained soils forming from shale.

These soils are used mainly for native range, but some gently sloping areas of Summit soils are mowed for native hay. The potential of these soils for grasses is fair. Where the soils are used for sanitary facilities and community development, their limitations should be overcome by special design. Controlling brush, improving or maintaining the quality of native grasses, and protecting the soils from fire are the main concerns of managing these soils.

7. Grainola-Shidler-Stoneburg association

Moderately deep and very shallow, very gently sloping to steep, loamy soils over limy shales, limestone, and sandstone; on ridge crests and side slopes

This association makes up about 3 percent of the county. Grainola soils make up about 27 percent of the association; Shidler soils, 20 percent; Stoneburg soils, 10 percent; and minor soils, the rest. The minor soils are in the Lucien, Corbin, and Verdigris series. Oil-waste land is also in this association.

Grainola soils are moderately deep, sloping to steep, well drained, loamy soils with a clayey subsoil. They formed from limy, reddish shales on side slopes.

Shidler soils are very shallow, stony, very gently sloping to sloping, somewhat excessively drained, loamy soils formed from limestone on ridge crests and in contour bands around side slopes.

Stoneburg soils are moderately deep, gently sloping to strongly sloping, well drained, loamy soils formed from reddish sandstone on ridge crests.

The soils of this association are used mainly for native range. Some areas of the Stoneburg soils are used for hay meadows or tame pasture. Shidler soils are quarried in local areas for gravel or stones for riprap. These soils have fair potential for grasses. Where the soils are used for sanitary facilities or community development, their limitations should be overcome by special design. Managers of these soils are concerned with improving or

maintaining the quality of grasses by controlling brush, following suitable grazing practices, and protecting the soils from fire.

8. Corbin-Pawhuska association

Deep, very gently sloping and gently sloping, loamy soils over reddish limy shales and sandstone

This association makes up about 2 percent of the county. Corbin soils make up about 40 percent of the association; Pawhuska soils, 20 percent; and minor areas of Stoneburg, Norge, Lucien, and Verdigris soils make up the rest.

Corbin soils are deep, very gently sloping to gently sloping, moderately well drained, loamy soils with a clayey subsoil. They formed from interbedded reddish shales and sandstone.

Pawhuska soils are deep, nearly level to gently sloping, poorly drained soils high in content of sodium. They have a thin, light colored, loamy surface layer and a dense, clayey subsoil. They formed from interbedded reddish shales and sandstone.

These soils are used mostly for native range, but some are used for tame pasture and native hay meadows. In places these soils are cultivated to small grains, grain sorghums, soybeans, and cotton.

The main concerns of managing these soils for cropland are maintaining or improving fertility and soil tilth and controlling erosion. These soils have good potential for crops and grasses. Where the soils are used for community development or sanitary facilities, their limitations should be overcome by special design. In addition, management is needed to reduce surface crusting and overcome the limitations of sodium in the Pawhuska soils. On range, management is needed to improve or maintain the native grasses by controlling brush, following suitable grazing practices, and protecting the soils from fire.

9. Norge-Vanoss association

Deep, nearly level to sloping, well drained, loamy soils over loamy sediments

This association makes up about 3 percent of the county. Norge soils make up about 67 percent of the association; Vanoss soils, 10 percent; and minor soils, the rest. The minor soils are in the Teller, Minco, Corbin, and Pawhuska series.

Norge soils are deep, very gently sloping to sloping, well drained, loamy soils with a reddish loamy subsoil.

Vanoss soils are deep, nearly level to very gently sloping, well drained, loamy soils with a brownish, loamy subsoil.

These soils are used mainly for tame pasture or are cultivated to small grains, grain sorghums, soybeans, alfalfa, cotton, or corn. Some areas are used for native range or native hay meadows. The soils in this association are adapted to a wider selection of crops and grasses than are the soils in any other association in Osage County.

These soils have good potential for crops and grasses. They can also be used for sanitary facilities, community development, and recreational development. Managers of these soils are concerned with maintaining or improving fertility and soil tilth and protecting the soils from erosion.

Deep to Shallow, Loamy and Sandy Soils on Wooded Uplands

The three associations in this group make up about 34 percent of Osage County. The soils are used mainly for native range or tame pasture. Some of the moderately deep and deep soils are cultivated to small grains, cotton, or grain sorghums. Some trees are cut for fenceposts and firewood. The native vegetation is mostly post oak, blackjack oak, and hickory with an understory of native tall grasses.

10. Niotaze-Darnell association

Moderately deep and shallow, gently sloping to steep, loamy soils over shale and sandstone; on ridge crests and side slopes

This association makes up about 15 percent of the county. Niotaze soils make up about 61 percent of this association; Darnell soils, 10 percent; and minor soils, the rest. The minor soils are of the Cleora, Stephenville, Steedman, Coweta, Foraker, Shidler, and Verdigris series. Oil-waste land is also in this association.

Niotaze soils are moderately deep, gently sloping to steep, somewhat poorly drained, loamy soils with a clayey subsoil. They formed from shale.

Darnell soils are shallow, gently sloping to steep, well drained to somewhat excessively drained, loamy soils formed from sandstone.

These soils are used for native range, woodland, or wildlife. A few areas have been cleared and sprigged to bermudagrass for tame pasture. Niotaze soils are well suited to pond reservoirs or lagoons but have severe limitations for septic filter fields. These soils have good potential for community, wildlife, and recreational development, but the limitations should be overcome by special design. Management is needed to improve or maintain the quality of grasses by controlling brush, following suitable grazing practices, and protecting the soils from fire.

11. Dougherty-Eufaula association

Deep, nearly level to moderately steep, sandy soils over sandy sediments

This association makes up about 4 percent of the county. Eufaula soils make up about 32 percent of the association; Dougherty soils, 35 percent; and minor soils, the rest. The minor soils are of the Darnell, Konawa, and Stephenville series.

Dougherty soils are very gently sloping to sloping, well drained soils with a sandy surface layer and a loamy subsoil. The surface layer is 20 to 40 inches thick.

Eufaula soils are nearly level to moderately steep, somewhat excessively drained soils with a sandy surface layer more than 40 inches thick.

Most of the nearly level and very gently sloping soils have been cleared and are used for tame pasture or are cultivated to small grains, cotton, or grain sorghums. The steeper sloping soils are used mainly for native range, woodland, or wildlife.

In cultivated acreage, the main concerns of managing these soils are controlling soil blowing and water erosion, maintaining soil fertility, and increasing the moisture-storing capacity of the soils. These soils have good potential for community development and sanitary facilities. On soils used for native range, the main concerns of management are controlling brush, controlling grazing, and protecting the soils from fire.

12. Darnell-Stephenville association

Shallow and moderately deep, very gently sloping to sloping, loamy soils over sandstone

This association makes up about 15 percent of the county. Darnell soils make up about 55 percent of the acreage; Stephenville soils, 21 percent; and minor soils, the rest. Minor soils are in the Gasil, Niotaze, and Cleora series. Pits and Oil-waste land are also in this association.

Darnell soils are shallow, very gently sloping to sloping, well drained to somewhat excessively drained, loamy soils on ridge crests and in contour bands around the side slopes.

Stephenville soils are moderately deep, very gently sloping to sloping, well drained, loamy soils on ridge crests and side slopes between bands of Darnell soils.

These soils are used mainly for native range or are cleared of brush and used for tame pasture, but in places the soils are cultivated to small grains. Some are used for woodland and wildlife.

These soils have good potential for community development, sanitary facilities, recreation, and wildlife development. Where the soils are used for these purposes, their limitations should be overcome by special design. Management of the soil is needed in cultivated acreage to maintain fertility and soil tilth and to protect the soils from blowing and water erosion. On range, controlling brush, following suitable grazing practices, and protecting the soils from fire are the main concerns of management.

Soil Map for Detailed Planning

The kinds of soil (mapping units) shown on the detailed soil map at the back of this publication are described in this section. The descriptions together with the soil maps can be useful in determining the potential of a soil and in managing it for food and fiber production; in planning land use and developing soil resources; and in enhancing, protecting, and preserving the environment. More information for each soil is given in the section "Use and Management of the Soils."

Preceding the name of each mapping unit is the symbol that identifies the unit on the detailed soil map. Each mapping unit description includes general facts about the soil and a brief description of the soil profile. In each description, the principal hazards and limitations are indicated and the management concerns and practices needed are discussed.

A soil mapping unit represents an area on the landscape and consists mostly of the soil or soils for which the unit is named. Most of the delineations shown on the detailed soil map at the back of this publication are phases of soil series.

Soils that have profiles that are almost alike make up a *soil series*. Except for allowable differences in texture of the surface layer or of the underlying substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement in the profile. A soil series commonly is named for a town or geographic feature near the place where a soil of that series was first observed and mapped. All the soils in the United States having the same series name have essentially the same properties that affect their use and their response to management practices.

Soils of one series can differ in texture of the surface layer or in the underlying substratum and in slope, erosion, stoniness, salinity, wetness, or other characteristic that affects the use of the soils. On the basis of such differences, a soil series is divided into phases. The name of a *soil phase* commonly indicates a feature that affects use or management. For example, Wynona silty clay loam is one of several phases within the Wynona series.

Some mapping units are made up of two or more dominant kinds of soil. Two such kinds of mapping units are shown on the soil map of this survey area: soil complex and undifferentiated group.

A *soil complex* consists of areas of two or more soils that are so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and proportion are somewhat similar in all areas. Coweta-Bates complex is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because there is little value in separating them. The pattern and proportion of the soils are not uniform. An area shown on the map has at least one of the dominant (named) soils or may have all of them. Kiomatia soils is an undifferentiated group in this survey area.

Most mapping units include small, scattered areas of soils other than those that appear in the name of the mapping unit. Some of these soils have properties that differ substantially from those of the dominant soil or soils and thus could significantly affect use and management of the mapping unit. The soils that are included in

mapping are recognized in the description of each mapping unit. Some of the more unusual or strongly contrasting soils that are included are identified by a special symbol on the soil map.

Most mapped areas include places that have little or no soil material and support little or no vegetation. Such places are called *miscellaneous areas*; they are delineated on the soil map and given descriptive names. Oil-waste land is an example. Some of these areas are too small to be delineated and are identified by a special symbol on the soil map.

The acreage and proportionate extent of each mapping unit are given in table 4, and additional information on properties, limitations, capabilities, and potentials for many soil uses are given for each kind of soil in other tables in this survey. (See "Summary of Tables.") Many of the terms used in describing soils are defined in the Glossary.

Soil Descriptions, Potentials, and Management

1—Apperson silty clay loam, 1 to 3 percent slopes. This deep, moderately well drained, very gently sloping soil is on crests of uplands. Slopes are smooth and convex. Individual areas are 10 to 60 acres.

Typically the surface layer is black silty clay loam to a depth of 9 inches. The upper part of the subsoil, to a depth of 17 inches, is black silty clay loam. The middle part, to a depth of 41 inches, is black and very dark gray silty clay. The lower part, to a depth of 50 inches, is dark grayish brown silty clay. Below this is hard limestone bedrock.

About 15 percent of this mapping unit is included areas of Summit soils, 10 percent is Okemah soils, 10 percent is Wolco soils, 2 percent is Shidler soils, and 10 percent is soils that are similar to Apperson soils except that they are 20 to 40 inches thick over limestone. Inextensive areas of Dwight soils are also included.

This soil has a seasonal water table 1 1/2 to 2 feet below the surface. Permeability is slow, and available water capacity is medium. The soil is used mainly for range. It is also suited to tame pasture grasses, wheat, soybeans, grain sorghum, corn, alfalfa, and other crops.

Management is needed to maintain soil tilth and fertility and to control erosion. Minimum tillage and the use of cover crops, including grasses and legumes, in the cropping system reduce runoff and control erosion. The tilth and fertility can be maintained by adding crop residue and fertilizer to the soil. Erosion is a moderate hazard. The quality of grasses can be maintained or improved by using suitable grazing practices, protecting the soil from fire, and adding fertilizer where needed.

The shrink-swell potential, low strength, and wetness can be overcome by special design where this soil is used for community development. Capability unit IIe-1; Loamy Prairie range site.

2—Apperson-Dwight, complex, 0 to 3 percent slopes. This complex consists of small areas of Apperson and Dwight soils that are so intermingled that they could not be separated at the scale selected for mapping. These soils are on crests of uplands. Individual areas of the mapping unit are 20 to 200 acres. Individual areas of each soil are 1 to 15 acres.

The Apperson soil makes up about 35 percent of the mapped acreage. It is a deep, moderately well drained, nearly level through very gently sloping soil. It is on the slightly higher, convex parts of the landscape. Typically the surface layer is black silty clay loam to a depth of 12 inches. The upper part of the subsoil is black silty clay loam to a depth of 16 inches. The next part is black and very dark grayish brown silty clay to a depth of 26 inches. The lower part is dark grayish brown silty clay to a depth of 46 inches. Below this is hard limestone bedrock.

This soil has a seasonal water table 1 1/2 to 2 feet below the surface. Permeability is slow, and available water capacity is medium.

The Dwight soil makes up about 30 percent of the mapped acreage. It is a deep, moderately well drained, nearly level through very gently sloping soil. It is on the slightly lower, concave parts of the landscape. Typically, the surface layer is very dark gray silt loam to a depth of 5 inches. The upper part of the subsoil is black and very dark grayish brown silt clay to a depth of 26 inches. The lower part is olive brown silty clay to a depth of 50 inches. Below this is hard limestone bedrock.

This soil has excessive amounts of exchangeable sodium in the upper part of the subsoil. Available water capacity is low, and permeability is very slow.

About 15 percent of this mapping unit is included areas of soils that are similar to Apperson soils except that they are 20 to 40 inches thick to bedrock, 15 percent is soils that are similar to Parsons soils except that they have higher amounts of exchangeable sodium in the upper part of the subsoil, and 5 percent is Wolco or Shidler soils.

These soils are used mostly for range. They are also suited to alfalfa, grain sorghum, small grains, tame pasture grasses, and other crops.

Management is needed to improve and maintain soil tilth, reduce surface crusting, maintain soil fertility, and control erosion. Returning adequate amounts of crop residue and fertilizer improves the soil structure, reduces surface crusting, controls erosion, and helps maintain soil fertility. Tilling these soils on the contour and at variable depths helps to control runoff and increase water intake. Tillage should be timely and kept to a minimum. Tilling or grazing these soils when wet causes excessive compaction. The quality of grasses can be maintained or improved by using suitable grazing practices, protecting soils from fire, and adding fertilizer where needed.

The shrink-swell potential, high exchangeable sodium content, low strength, and wetness can be overcome by special design where soils are used for community

development. Capability unit IVs-1; Apperson part in Loamy Prairie range site, Dwight part in Shallow Claypan range site.

3—Barnsdall very fine sandy loam. This deep, well drained, nearly level soil is on flood plains. Slopes are smooth and convex. Individual areas are 5 to 30 acres.

Typically the surface layer is dark brown very fine sandy loam to a depth of 7 inches. The subsurface layer is brown very fine sandy loam to a depth of 11 inches. The upper part of the subsoil is reddish brown silty clay loam to a depth of 45 inches. The lower part is reddish brown clay loam to a depth of 58 inches. The underlying material is brown fine sandy loam to a depth of 72 inches.

About 15 percent of this mapping unit is included areas of Mason soils. Also included are inextensive areas of Verdigris soils.

This soil is rarely flooded. Permeability is moderate, and available water capacity is high. The soil is used mainly for growing small grains, grain sorghum, alfalfa, tame pasture grasses, and trees. It is also suited to corn, peanuts, soybeans, native grasses, and other crops.

Management is needed to maintain soil fertility and tilth. This can be done by effectively using crop residue, using legumes and grasses in the cropping system, adding fertilizer, and avoiding excessive tillage. Crops that produce large amounts of residue can be grown continuously where adequate plant food and crop residue are returned to the soil annually.

Flooding, low strength, and shrink-swell can be overcome by special design where these soils are used for community development. Capability unit I-1; Loamy Bottomland range site.

4—Bates loam, 1 to 3 percent slopes. This moderately deep, well drained, very gently sloping soil is on crests and side slopes of uplands. Slopes are smooth and convex. Individual areas are 15 to 40 acres.

Typically the surface layer is very dark grayish brown loam to a depth of 10 inches. The upper part of the subsoil is dark brown loam to a depth of 16 inches. The middle part is dark brown clay loam to a depth of 24 inches. The lower part is yellowish brown sandy clay loam to a depth of 36 inches. Below this is soft sandstone bedrock.

About 10 percent of this mapping unit is included areas of soils that are similar to Bates soils except that the thickness to bedrock is 40 to 60 inches, 10 percent is Coweta soils, 5 percent is Dennis soils, and 2 percent is Steedman soils.

Permeability is moderate, and available water capacity is medium. This soil is used mainly for tame pasture, hay meadows, and range. It is also suited to alfalfa, grain sorghum, small grains, soybeans, and other crops.

Management is needed to maintain soil fertility and tilth and control erosion. Erosion can be controlled by using crop residue, terracing, and contour farming. Crops that produce large amounts of residue can be grown continuously where fertilizer and crop residue are returned to the soil. Terracing and contour farming are needed where row crops are grown. Excessive tillage should be avoided. The quality of grasses can be maintained or improved by using suitable grazing practices, protecting the soil from fire, and adding fertilizer where needed.

The limitation of soil thickness to bedrock can be overcome by special design where these soils are used for sanitary facilities or community development. Capability unit IIe-2; Loamy Prairie range site.

5—Bates loam, 3 to 5 percent slopes. This moderately deep, well drained, gently sloping soil is on crests and side slopes of uplands. Slopes are smooth and convex. Individual areas are 10 to 30 acres.

Typically the surface layer is very dark grayish brown loam to a depth of 11 inches. The upper part of the subsoil is dark grayish brown loam to a depth of 15 inches. The lower part is brown sandy clay loam to a depth of 34 inches. Below this is soft sandstone bedrock.

About 15 percent of this mapping unit is included areas of Prue soils, 15 percent is Coweta soils, and 2 percent is Steedman soils.

Permeability is moderate, and available water capacity is medium. The soil is used mainly for range and tame pasture. It is also suited to small grains, grain sorghum, soybeans, and other crops.

Management is needed to control erosion and maintain soil fertility and tilth. The severe erosion hazard can be reduced by proper use of crop residue, terracing, and contour farming. Where row crops are grown, contour farming and terraces are needed. Crops that produce large amounts of residue should be managed for soil improvement. Fertilizer should be added for economical production. Minimum tillage and including grasses and legumes in the cropping system help reduce runoff and control erosion. The quality of grasses can be maintained or improved by using suitable grazing practices, protecting from fire, and adding fertilizer where needed.

The limitations of soil thickness to bedrock and the slope can be overcome by special design where these soils are used for sanitary facilities or community development. Capability unit IIIe-3; Loamy Prairie range site.

6—Catoosa-Shidler complex, 1 to 3 percent slopes. This complex consists of small areas of Catoosa and Shidler soils that are so intermingled that they could not be separated at the scale selected for mapping. These soils are on crests and valleys of uplands. Individual areas of the mapping unit are 20 to 150 acres. Individual areas of each soil are 1 to 15 acres.

The Catoosa soil makes up about 40 percent of the mapped acreage. It is a moderately deep, well drained, very gently sloping soil in slightly lower areas. Typically the surface layer is dark brown silt loam to a depth of 9 inches. The subsoil is dark reddish brown silty clay loam to a depth of 30 inches. Below this is hard limestone bedrock.

Permeability is moderate, and available water capacity is medium.

The Shidler soil makes up about 30 percent of the mapped acreage. It is a shallow, well drained, very gently sloping soil in slightly higher areas. Typically the surface

layer is dark brown silty clay loam to a depth of 8 inches. Below this is hard limestone bedrock.

Permeability is moderate, and available water capacity is low.

About 10 percent of this mapping unit is included areas of Lula soils, 5 percent is soils that are similar to Catoosa soils except that thickness to bedrock is 10 to 20 inches, 5 percent is soils that are similar to Catoosa soils except that the subsoil is slightly more clayey, and 10 percent is soils that are similar to Shidler soils except that they contain more than 35 percent, by volume, limestone fragments. Inextensive areas of limestone bedrock exposed at the surface are also included.

These soils are used mostly for range and hay meadows. In some areas the bedrock is quarried and used for agricultural lime and gravel. The soils are also suited to tame pasture grasses.

Management is needed to keep the higher producing grasses, forbs, and legumes growing vigorously. The quality and quantity of vegetation can be maintained or improved by following suitable grazing practices, protecting the soils from fire, and applying needed fertilizer to hay meadow grasses and tame pasture grasses.

The limitations of soil thickness to bedrock can be overcome by special design where these soils are used for community development. Capability unit IVe-3; Catoosa part in Loamy Prairie range site, Shidler part in Very Shallow Prairie range site.

7—Choska very fine sandy loam. This deep, well drained, nearly level soil is on flood plains. Individual areas are 10 to 40 acres.

Typically the surface layer is dark brown very fine sandy loam to a depth of 9 inches. The underlying material is brown very fine sandy loam to a depth of 65 inches.

About 10 percent of this mapping unit is included areas of Kiomatia soils and 5 percent is Mason soils.

This soil is occasionally flooded. Permeability is moderate, and available water capacity is high.

The soil is suited to alfalfa, grain sorghum, small grains, tame pasture grasses, corn, peanuts, soybeans, range grasses, trees, and other crops.

Management is needed to protect the soil from flooding and to maintain soil tilth and fertility. The soil tilth and fertility can be maintained by returning adequate amounts of crop residue and fertilizer to the soil. The quality of tame pasture grasses can be maintained or improved by following suitable grazing practices, protecting the soil from fire, and adding fertilizer where needed.

Flooding can be overcome by special design where these soils are used for sanitary facilities, community development, or recreation. Capability unit IIw-2; Loamy Bottomland range site.

8—Cleora fine sandy loam. This deep, well drained, nearly level soil is on flood plains. Slopes are smooth and convex. Individual areas are 5 to 15 acres.

Typically the surface layer and the next layer are very dark grayish brown fine sandy loam to a depth of 12 inches. The subsoil is dark brown fine sandy loam to a depth of 25 inches. The underlying material is dark yellowish brown fine sandy loam and yellowish brown loamy fine sand to a depth of 60 inches.

About 15 percent of this mapping unit is included areas of soils that are similar to Cleora soils except that the subsoil and underlying materials are slightly more clayey, small areas of soils that are similar to Cleora soils except that the surface layer is slightly lighter in color, 2 percent is soils that are similar to Cleora soils except that the dark colored material is slightly thicker, and 2 percent is Verdigris soils.

This soil is occasionally flooded. Permeability is moderately rapid, and available water capacity is medium. The soil is used mainly for tame pasture. It is also suited to alfalfa, grain sorghum, small grains, corn, peanuts, soybeans, trees, and other crops.

Management is needed to protect the soil from flooding and to maintain soil structure and fertility. The soil tilth and fertility can be maintained by returning adequate amounts of crop residue and fertilizer to the soil. The quality and quantity of tame pasture grasses can be maintained or improved by followng suitable grazing practices, protecting the soil from fire, and applying the needed fertilizer.

Flooding can be overcome by special design where this soil is used for sanitary facilities, community development, or recreation. Capability unit IIw-2; Loamy Bottomland range site.

9—Cleora fine sandy loam, undulating. This deep, well drained, nearly level through very gently sloping soil is on flood plains. Slopes are undulating. Individual areas are 5 to 15 acres.

Typically the surface layer is very dark grayish brown fine sandy loam to a depth of 16 inches. The subsoil is dark brown fine sandy loam to a depth of 36 inches. The underlying material is brown loamy fine sand and fine sandy loam to a depth of 72 inches.

About 15 percent of this mapping unit is included areas of soils that are similar to Cleora soils except that the surface layer is slightly lighter in color, and 10 percent is soils that are similar to Cleora soils except that the subsoil and underlying material are slightly more clayey. Also included are inextensive areas of Verdigris soils.

This soil is occasionally flooded. Permeability is moderately rapid, and available water capacity is medium.

The soil is used mostly for tame pasture. It is suited to alfalfa, grain sorghum, peanuts, small grains, corn, soybeans, trees, and other crops.

Management is needed to protect the soil from flooding and to maintain soil tilth and fertility. The soil tilth and fertility can be maintained by returning adequate amounts of crop residue and fertilizer to the soil. The quality of tame pasture grasses can be maintained or improved by following suitable grazing practices, protecting the soil from fire, and applying the needed fertilizer.

Flooding can be overcome by special design where this soil is used for sanitary facilities, community development, or recreation. Capability unit IIe-3; Loamy Bottomland range site.

10—Corbin silt loam, 1 to 3 percent slopes. This deep, well drained, very gently sloping soil is on crests and side slopes of uplands. Slopes are smooth and convex. Individual areas are 10 to 30 acres.

Typically the surface layer is black silt loam to a depth of 11 inches. The upper part of the subsoil is very dark brown and dark brown silty clay loam to a depth of 30 inches. The middle part is reddish brown silty clay to a depth of 64 inches. The lower part is mottled in shades of brown, yellow, and gray silty clay to a depth of 74 inches.

About 10 percent of this mapping unit is included areas of soils that are similar to Corbin soils except that the thickness to bedrock is less than 60 inches, and 10 percent is Norge soils. Also included are inextensive areas of Grainola soils.

Permeability of this soil is slow, and available water capacity is high. The soil is used mostly for range and hay meadows. It is also suited to alfalfa, grain sorghum, small grains, tame pasture grasses, soybeans, corn, and other crops.

Management is needed to maintain tilth and fertility and to control erosion. Minimum tillage and the use of cover crops, including grasses and legumes, in the cropping system reduce runoff and control erosion. The tilth and fertility can be maintained by adding crop residue and fertilizer to the soil. Erosion is a moderate hazard. The quality of grasses can be maintained or improved by using suitable grazing practices, protecting the soil from fire, and adding fertilizer where needed.

The shrink-swell potential and low strength can be overcome by special design where this soil is used for community development. Capability unit IIe-1; Loamy Prairie range site.

11—Corbin silt loam, 3 to 5 percent slopes. This deep, well drained, gently sloping soil is on side slopes of uplands. Slopes are smooth and convex. Individual areas are 10 to 35 acres.

Typically the surface layer is very dark gray silt loam to a depth of 9 inches. The upper part of the subsoil is very dark brown and dark brown silty clay loam to a depth of 26 inches. The middle part is dark brown silty clay to a depth of 41 inches. The lower part is silty clay mottled in shades of red, yellow, brown, and gray to a depth of 72 inches.

About 15 percent of this mapping unit is included areas of Norge soils, and 5 percent is soils that are similar to Corbin soils except that thickness to bedrock is less than 60 inches. Also included are inextensive areas of Lucien, Grainola, and Pawhuska soils.

Permeability is slow and available water capacity is high.

The soil is used mostly for range. It is also suited to grain sorghum, small grains, corn, tame pasture grasses, soybeans, and other grasses.

Management is needed to control erosion and maintain fertility and tilth. The severe erosion hazard can be reduced by proper use of crop residue, terracing, and contour farming. Where row crops are grown, contour farming and terraces are needed. Crops that produce large amounts of residue should be managed for soil improvement. Fertilizer should be added for economical production. Minimum tillage and including grasses and legumes in the cropping system reduce runoff and soil erosion. The quality of grasses can be maintained or improved by using suitable grazing practices, protecting the soil from fire, and adding fertilizer where needed.

The shrink-swell potential and low strength can be overcome by special design where this soil is used for community development. Capability unit IIIe-2; Loamy Prairie range site.

12—Corbin-Pawhuska complex, 1 to 5 percent slopes. This complex consists of small areas of Corbin and Pawhuska soils that are so intermingled that they could not be separated at the scale selected for mapping. These soils are on crests and side slopes of uplands. Individual areas of the mapping unit are 15 to 80 acres. Individual areas of each soil are 1 to 15 acres.

The Corbin soil makes up about 40 percent of the mapped acreage. It is a deep, well drained, very gently sloping through gently sloping soil. It is on the slightly higher, convex parts of the landscape. Typically the surface layer and the next layer are very dark grayish brown silt loam to a depth of 14 inches. The upper part of the subsoil is dark brown and reddish brown silty clay loam to a depth of 27 inches. The middle part is reddish brown silty clay to a depth of 63 inches. The lower part is silty clay loam coarsely mottled in shades of brown, yellow, and gray to a depth of 73 inches. The underlying material is silty clay loam, shale, siltstone, and sandstone coarsely mottled in shades of brown and gray to a depth of 92 inches.

Permeability is slow and available water capacity is high.

The Pawhuska soil makes up about 20 percent of the mapped acreage. It is a deep, moderately well drained, very gently sloping through gently sloping soil. It is on the slightly lower, concave parts of the landscape. Typically the surface layer is very dark grayish brown silt loam to a depth of 3 inches. The upper part of the subsoil is dark brown and dark reddish gray silty clay to a depth of 18 inches. The middle part is reddish brown silty clay to a depth of 50 inches. The lower part is reddish brown silty clay loam to a depth of 80 inches.

This soil has excessive amounts of exchangeable sodium in the upper part of the subsoil. Available water capacity is low, and permeability is very slow.

About 20 percent of this mapping unit is included areas of soils similar to Corbin soils except that thickness to bedrock is less than 60 inches, 15 percent is soils that are similar to Pawhuska soils except that the upper part of the subsoil has slightly less amounts of exchangeable sodium, and 5 percent is Norge soils. Inextensive areas of Lucien soils are also included.

These soils are used mostly for range and tame pasture. They are also suited to grain sorghum, small grains, soybeans, and other crops.

Management is needed to improve and maintain tilth and fertility, reduce surface crusting, and control erosion. Returning adequate amounts of crop residue and fertilizer to these soils reduces surface crusting, controls erosion, and helps maintain soil fertility. Tilling these soils on the contour helps to control runoff and increase water intake. Tillage should be timely and kept to a minimum. Tilling or grazing these soils when wet causes excessive compaction. The quality of grasses can be maintained or improved by using suitable grazing practices, protecting the soil from fire, and adding fertilizer where needed.

The shrink-swell potential, high exchangeable sodium content, and low strength can be overcome by special design where these soils are used for community development. Capability unit IVs-1; Corbin part in Loamy Prairie range site, Pawhuska part in Shallow Claypan range site.

13—Coweta-Bates complex, 1 to 8 percent slopes. This complex consists of small areas of Coweta and Bates soils that are so intermingled that they could not be separated at the scale selected for mapping. These soils are on crests and side slopes of uplands. Individual areas of the mapping unit are 10 to 160 acres. Individual areas of each soil are 5 to 20 acres.

The Coweta soil makes up about 45 percent of the mapped acreage. It is a shallow, well drained to somewhat excessively drained, very gently sloping through sloping soil. It is on the slightly higher, convex parts of the landscape. Typically the surface layer is very dark grayish brown loam to a depth of 9 inches. The subsoil is dark brown loam to a depth of 16 inches. The underlying material is sandstone bedrock.

This soil has moderate permeability and low available water capacity.

The Bates soil makes up about 20 percent of the mapped acreage. It is a moderately deep, well drained, very gently sloping through sloping soil. It is on the slightly lower, convex parts of the landscape. Typically the surface layer is very dark grayish brown loam to a depth of 12 inches. The subsoil is brown and yellowish brown sandy clay loam to a depth of 26 inches. The underlying material is sandstone bedrock.

This soil has moderate permeability and medium available water capacity.

About 15 percent of this mapping unit is included areas of soils that are similar to Coweta soils except that the thickness to bedrock is less than 10 inches, 5 percent is sandstone bedrock exposed at the surface, 5 percent is Dennis soils, 5 percent is Prue soils, and 5 percent is Steedman soils. Inextensive areas of soils that are similar to Bates soils except that thickness to bedrock is 40 to 60 inches are also included.

These soils are used mostly for range and hay meadows. They are also suited to tame pasture grasses.

Management is needed to keep the higher producing grasses, forbs, and legumes growing vigorously. The quality of vegetation can be maintained or improved by following suitable grazing practices, protecting the soils from fire, and applying needed fertilizer to hay meadow grasses and tame pasture grasses.

The limitation of soil thickness to bedrock can be overcome by special design where these soils are used for community development. Capability unit VIs-3; Coweta part in Shallow Prairie range site, Bates part in Loamy Prairie range site.

14—Darnell-Stephenville complex, 1 to 8 percent slopes. This complex consists of small areas of Darnell and Stephenville soils that are so intermingled that they could not be separated at the scale selected for mapping (fig. 3). These soils are on crests and side slopes of uplands. Individual areas of the mapping unit are 20 to 350 acres. Individual areas of each soil are 5 to 20 acres.

The Darnell soil makes up about 50 percent of the mapped acreage. It is a shallow, well drained to somewhat excessively drained, very gently sloping through sloping soil. It is on the slightly higher part of the landscape. Typically the surface layer is very dark grayish brown fine sandy loam to a depth of 4 inches. The subsoil is dark brown fine sandy loam to a depth of 12 inches. The underlying material is soft sandstone bedrock.

This soil has moderately rapid permeability and low available water capacity.

The Stephenville soil makes up about 20 percent of the mapped acreage. It is a moderately deep, well drained, very gently sloping through sloping soil. It is on the slightly lower, convex parts of the landscape. Typically the surface layer is very dark brown fine sandy loam to a depth of 3 inches. The subsurface layer is brown fine sandy loam to a depth of 8 inches. The upper part of the subsoil is strong brown sandy clay loam to a depth of 21 inches. The lower part is mottled in shades of brown and red sandy clay loam to a depth of 26 inches. The underlying material is soft sandstone bedrock.

This soil has moderate permeability and medium available water capacity.

About 10 percent of this mapping unit is included areas of Niotaze soils, 5 percent is Gasil soils, 5 percent is Steedman soils, 5 percent is soils that are similar to Darnell soils except that the thickness to bedrock is less than 10 inches, and 5 percent is soils that are similar to Stephenville soils except that thickness to bedrock is 40 to 60 inches. Inextensive areas of Coweta, Bates, Teller, Konawa, Dougherty, Eufaula, and Shidler soils are also included.

These soils are used mostly for range. They are also suited to tame pasture grasses and trees for firewood.

Management is needed to keep the more desirable and productive vegetation growing vigorously. The quantity and quality of vegetation can be maintained or improved by controlling brush, following suitable grazing practices, and applying needed fertilizer to tame pasture grasses.

The limitation of soil thickness to bedrock can be overcome by special design where these soils are used for community development. Capability unit VIs-3; Darnell part in Shallow Savannah range site, Stephenville part in Sandy Savannah range site.

15—Dennis silt loam, 1 to 3 percent slopes. This deep, moderately well drained, very gently sloping soil is on

valleys and side slopes of uplands. Slopes are smooth and convex. Individual areas are 20 to 60 acres.

Typically the surface layer is very dark brown silt loam to a depth of 13 inches. The upper part of the subsoil is dark brown and brown silty clay loam to a depth of 32 inches. The middle part is brown silty clay to a depth of 42 inches. The lower part is silty clay mottled in shades of brown and red to a depth of 62 inches.

About 30 percent of this mapping unit is included areas of soils that are similar to Dennis soils except that thickness to bedrock is less than 60 inches, 10 percent is Okemah soils, and 5 percent is Steedman soils. Inextensive areas of Bates, Coweta, Parsons, and Pawhuska soils are also included.

This soil has a seasonal water table 2 to 3 feet below the surface. Permeability is slow, and available water capacity is high. The soil is used mainly for tame pasture, hay meadows, and range. It is also suited to alfalfa, grain sorghum, small grains, corn, soybeans, and other crops.

Management is needed to maintain soil tilth and fertility and to control erosion. Minimum tillage and the use of cover crops, including grasses and legumes, in the cropping system help to reduce runoff and control erosion. The tilth and fertility can be maintained by adding crop residue and fertilizer to the soil. Erosion is a moderate hazard. The quality of grasses can be maintained or improved by following suitable grazing practices, protecting the soil from fire, and adding fertilizer where needed.

The shrink-swell potential, low strength, and wetness can be overcome by special design where this soil is used for community development. Capability unit IIe-1; Loamy Prairie range site.

16—Dennis silt loam, 3 to 5 percent slopes. This deep, moderately well drained, gently sloping soil is on side slopes of uplands. Slopes are smooth and convex. Individual areas are 10 to 40 acres.

Typically the surface layer is very dark brown silt loam to a depth of 11 inches. The upper part of the subsoil is very dark grayish brown and brown silty clay loam to a depth of 31 inches. The lower part is silty clay mottled in shades of brown and red to a depth of 62 inches.

About 30 percent of this mapping unit is included areas of soils that are similar to Dennis soils except that the thickness to bedrock is less than 60 inches, 5 percent is soils that are similar to Dennis soils except that the surface layer has been thinned by erosion, 10 percent is Steedman soils, and 3 percent is Okemah soils. Inextensive areas of Bates, Coweta, and Pawhuska soils are also included.

This soil has a seasonal water table 2 to 3 feet below the surface. Permeability is slow, and available water capacity is high.

The soil is used mainly for tame pasture and range. It is also suited to grain sorghum, small grains, corn, soybeans, and other crops.

Management is needed to maintain fertility and tilth and to protect the soil from excessive erosion. Terracing, contour farming, and using crop residue are needed in controlling erosion, conserving moisture, and maintaining soil tilth. Crop residue should be returned to the soil, fertilizer should be applied where needed, and excessive tillage should be avoided. The quality of grasses can be maintained or improved by using suitable grazing practices, protecting the soil from fire, and adding fertilizer where needed.

The shrink-swell potential, low strength, and wetness can be overcome by special design where this soil is used for community development. Capability unit IIIe-2; Loamy Prairie range site.

17—Dennis-Carytown complex, 1 to 5 percent slopes. This complex consists of small areas of Dennis and Carytown soils that are so intermingled that they could not be separated at the scale selected for mapping. These soils are on side slopes and valleys of uplands. Individual areas of the mapping unit are 25 to 125 acres. Individual areas of each soil are 1 to 20 acres.

The Dennis soil makes up about 30 percent of the mapped acreage. It is a deep, moderately well drained, very gently sloping through gently sloping soil. It is on the slightly higher, convex parts of the landscape. Typically the surface layer is very dark grayish brown silt loam to a depth of 9 inches. The upper part of the subsoil is very dark grayish brown silty clay loam to a depth of 18 inches. The middle part is dark brown and brown silty clay to a depth of 38 inches. The lower part is silty clay coarsely mottled in shades of gray and brown to a depth of 72 inches.

This soil has a seasonal water table 2 to 3 feet below the surface. Permeability is slow, and available water capacity is high.

The Carytown soil makes up about 20 percent of the mapped acreage. It is a deep, poorly drained, very gently sloping soil. It is on the slightly lower, concave parts of the landscape. Typically the surface layer is very dark grayish brown silt loam to a depth of 9 inches. The upper part of the subsoil is very dark grayish brown, dark grayish brown, and dark brown silty clay to a depth of 38 inches. The lower part is silty clay coarsely mottled in shades of gray and brown to a depth of 72 inches.

This soil has excessive amounts of exchangeable sodium in the upper part of the subsoil. A seasonal water table is at the surface to 1 foot below the surface. Permeability is very slow, and available water capacity is low.

About 25 percent of this mapping unit is included areas of soils that are similar to Dennis soils except that thickness to bedrock is less than 60 inches, 10 percent is soils that are similar to Carytown soils except that thickness to bedrock is less than 60 inches, 10 percent is Bates soils, and 5 percent is Okemah soils.

These soils are used mainly for range and tame pasture. They are also suited to grain sorghum, small grains, soybeans, and other crops.

Management is needed to improve and maintain tilth and fertility, reduce surface crusting, and control erosion. Returning adequate amounts of crop residue and fertil-

izer reduces surface crusting, controls erosion, and helps maintain fertility. Tilling these soils on the contour and at variable depths helps to control runoff and increase water intake. Tillage should be timely and kept to a minimum. Tilling or grazing these soils when wet causes excessive compaction. The quality of grasses can be maintained or improved by using suitable grazing practices, protecting the soils from fire, and adding fertilizer where needed.

The shrink-swell potential, high exchangeable sodium content, and low strength can be overcome by special design where these soils are used for community development. Capability unit IVs-1; Dennis part in Loamy Prairie range site, Carytown part in Shallow Claypan range site.

18—Dennis-Verdigris complex, 0 to 12 percent slopes. This complex consists of small areas of Dennis and Verdigris soils so intermingled that they could not be separated at the scale selected for mapping. These soils are in drainageways. Individual areas of the mapping unit are 15 to 60 acres. Individual areas of each soil are 3 to 15 acres.

The Dennis soil makes up about 30 percent of the mapped acreage. It is a deep, moderately well drained, very gently sloping through gently sloping soil. It is on side slopes of narrow upland drainageways. Typically the surface layer is very dark brown silt loam to a depth of 10 inches. The upper part of the subsoil is dark brown silty clay loam to a depth of 16 inches. The middle part is brown silty clay loam and silty clay to a depth of 36 inches. The lower part is silty clay mottled in shades of gray and brown to a depth of 64 inches. Below this is shale bedrock with thin layers of sandstone.

This soil has a seasonal water table 2 to 3 feet below the surface. Permeability is slow, and available water capacity is high.

The Verdigris soil makes up about 20 percent of the mapped acreage. It is a deep, moderately well drained, nearly level through very gently sloping soil. It is on concave flood plains. Typically the surface layer is black silt loam to a depth of 9 inches. The next layer is very dark brown silt loam to a depth of 19 inches. The subsoil is very dark grayish brown silty clay loam to a depth of 32 inches. The underlying material is dark grayish brown silty clay loam to a depth of 60 inches.

This soil is frequently flooded. Permeability is moderate, and available water capacity is high.

About 10 percent of this mapping unit is included areas of very gently sloping through strongly sloping soils that are similar to Dennis soils except that the thickness to bedrock is less than 60 inches; these soils are on the sides of prairie drainageways. About 30 percent is soils on uplands, such as Apperson, Bates, Corbin, Minco, Norge, Okemah, Parsons, Pawhuska, Prue, Steedman, Vanoss, and Wolco soils; and 10 percent is soils on flood plains, such as Barnsdall, Choska, Mason, Osage, and Wynona soils.

These soils are used mostly for range and tame pasture.

Management is needed to reduce runoff, control erosion, and divert water from higher-lying soils in some areas. The quality and quantity of grasses can be maintained or improved by following suitable growing practices, protecting the soil from fire, and applying needed fertilizer. Slope and flooding can be overcome by special design where these soils are used for community development. Capability unit VIe-1; Dennis part in Loamy Prairie range site, Verdigris part in Loamy Bottomland range site.

19—Dougherty loamy fine sand, 1 to 3 percent slopes. This deep, well drained, very gently sloping soil is on the crests of uplands. Slopes are convex and concave. Individual areas are 20 to 50 acres.

Typically the surface layer is very dark grayish brown loamy fine sand to a depth of 7 inches. The subsurface layer is brown loamy fine sand to a depth of 24 inches. The upper part of the subsoil is reddish brown sandy clay to a depth of 36 inches. The lower part of the subsoil is yellowish red sandy clay loam to a depth of 55 inches. The underlying material is yellowish red loamy fine sand to a depth of 62 inches.

About 15 percent of this mapping unit is included areas of soils that are similar to Dougherty soils except that the subsoil colors are more brown, 10 percent is Konawa soils, 5 percent is Eufaula soils, and 5 percent is Gasil soils.

This soil has moderate permeability and medium available water capacity. It is used mainly for range, tame pasture grasses, and trees for firewood and posts. It is also suited to grain sorghum, peanuts, small grains, and other crops.

Management is needed to control soil blowing and maintain soil fertility. Soil blowing can be controlled by stripcropping and by using cover crops that produce a large amount of residue. Tillage practices that leave most of the residue on the soil surface are desirable. Crops and tame pasture grasses can be maintained or improved by following suitable grazing practices, protecting the soil from fire, controlling brush, and applying needed fertilizer.

These soils are adapted to community development. Where they are used for recreational development, the sandy surface layer can be overcome by special design. Capability unit IIIe-6; Deep Sand Savannah range site.

20—Dougherty loamy fine sand, 3 to 8 percent slopes. This deep, well drained, gently sloping through sloping soil is on crests and side slopes of uplands. Slopes are convex and concave. Individual areas are 25 to 80 acres.

Typically the surface layer is dark brown loamy fine sand to a depth of 6 inches. The subsurface layer is brown loamy fine sand to a depth of 22 inches. The subsoil is yellowish red sandy clay loam to a depth of 50 inches. The underlying material is yellowish red loamy fine sand to a depth of 72 inches.

About 15 percent of this mapping unit is included areas of Konawa soils, 5 percent is Eufaula soils, and 10 percent is soils that are similar to Dougherty soils except that the subsoil is slightly less red and brown.

This soil has moderate permeability and medium available water capacity. It is used mostly for range, tame pasture grass, and trees for firewood and posts. It is also suited to grain sorghum, peanuts, small grains, and other crops.

Controlling soil blowing and water erosion and maintaining fertility are the main concerns of management. Soil blowing and water erosion can be controlled by planting to grasses, stripcropping, and using cover crops that produce a large amount of residue. Tillage practices that leave most of the residue on the soil surface are desirable. Crops and tame pasture grasses need application of fertilizer. The quality of grasses can be maintained or improved by following suitable grazing practices, protecting the soil from fire, controllng brush, and applying needed fertilizer.

These soils are adapted to community development. Where they are used for recreational development, the sandy surface layer should be overcome by special design. Capability unit IVe-5; Deep Sand Savannah range site.

21—Eufaula loamy fine sand, 3 to 15 percent slopes. This deep, somewhat excessively drained, gently sloping through moderately steep soil is on crests and side slopes of uplands (fig. 4). Slopes are convex and concave. Individual areas are 30 to 80 acres.

Typically the surface layer is very dark grayish brown loamy fine sand to a depth of 5 inches. The subsurface layer is light yellowish brown fine sand to a depth of 48 inches. The subsoil is alternating layers of pink fine sand and yellowish red loamy fine sand to a depth of 72 inches.

About 10 percent of this mapping unit is included areas of soils that are similar to Eufaula soils except that the subsoil is slightly more clayey, 15 percent is Dougherty soils, and 7 percent is soils that are similar to Eufaula soils except that the thickness to the subsoil is more than 72 inches.

This soil has rapid permeability and low available water capacity. It is used mostly for range, tame pasture, and trees for firewood and posts.

The quality of grasses can be maintained or improved by controlling brush, following suitable grazing practices, and protecting the soil from fire. Application of fertilizer on tame pasture grasses is needed.

The rapid intake of water and the slope can be overcome by special design where these soils are used for sanitary facilities. Capability unit VIe-4; Deep Sand Savannah range site.

22—Eufaula-Dougherty complex, 0 to 3 percent slopes. This complex consists of small areas of Eufaula and Dougherty soils so intermingled that they could not be separated at the scale selected for mapping. These soils are on crests of uplands. Slopes are convex and concave. Individual areas of the mapping unit are 20 to 120 acres. Individual areas of each soil are 5 to 30 acres.

Eufaula soil makes up about 75 percent of the mapped acreage. It is a deep, somewhat excessively drained, nearly level through very gently sloping soil. It is convex, uneven, slightly higher areas. Typically the surface layer is very dark grayish brown loamy fine sand to a depth of 6 inches. The subsurface layer is pale brown loamy fine sand to a depth of 58 inches. The subsoil is alternating layers of light brown fine sand and yellowish red loamy fine sand to a depth of 72 inches.

This soil has rapid permeability and low available moisture capacity.

Dougherty soil makes up about 15 percent of the mapped acreage. It is a deep, well drained soil in slightly lower areas. Typically the surface layer is very dark grayish brown loamy fine sand to a depth of 7 inches. The subsurface layer is brown loamy fine sand to a depth of 35 inches. The upper part of the subsoil is reddish brown sandy clay loam to a depth of 52 inches. The lower part is yellowish red fine sandy loam to a depth of 59 inches. The underlying material is yellowish red loamy fine sand to a depth of 72 inches.

This soil has moderate permeability and medium available water capacity.

About 10 percent of this mapping unit is included areas of soils that are similar to Dougherty soils except that the subsoil is more brown. Inextensive areas of Gasil soils are also included.

These soils are used mostly for tame pasture. They are also suited to range grasses, trees for firewood and posts, grain sorghums, peanuts, small grains, and other crops.

Management is needed to maintain or improve fertility and to control soil blowing. Stripcropping, minimum tillage, cover crops, crops that produce large amounts of residue, and addition of fertilizer help control soil erosion. The quality of grasses can be maintained or improved by controlling brush, following suitable grazing practices, and protecting the soil from fire. Application of fertilizer on pasture grasses is needed.

These soils are adapted to community development. Where they are used for recreational development, the sandy surface layer can be overcome by special design. Capability unit IVs-2; Deep Sand Savannah range site.

23—Foraker-Shidler complex, 12 to 25 percent slopes. This complex consists of small areas of Foraker and Shidler soils so intermingled that they could not be separated at the scale selected for mapping. These soils are on crests and side slopes of uplands. Slopes are smooth and convex. Individual areas of the mapping unit are 20 to 250 acres. Individual areas of each soil are 1 to 15 acres.

The Foraker soil makes up about 45 percent of the mapped acreage. It is a moderately deep, moderately well drained, moderately steep or steep soil in less stony areas between contour bands of Shidler soils. Typically the surface layer is black silty clay loam to a depth of 8 inches. The upper part of the subsoil is very dark gray silty clay loam to a depth of 11 inches. The middle part is dark gray silty clay to a depth of 26 inches. The lower part is olive gray shaly silty clay to a depth of 38 inches. Below this is shale bedrock.

This soil has slow permeability and medium available water capacity. A seasonal water table is at the surface to 2 feet below the surface.

The Shidler soil makes up about 30 percent of the mapped acreage. It is a shallow, well drained, moderately steep soil in more stony bands between areas of Foraker soils. Typically the surface layer is very dark brown silty clay loam to a depth of 8 inches. Below this layer is hard limestone bedrock.

This soil has moderate permeability and low available water capacity.

About 5 percent of this mapping unit is included areas of Apperson soils, 5 percent is Coweta soils, 5 percent is Grainola soils, and 5 percent is Summit soils. Also included are small areas of soils that are similar to Shidler soils except that the surface layer is slightly more clayey.

These soils are used mostly for range. The limestone bedrock of Shidler soil is mined for gravel and other uses in some areas.

The quality and quantity of grasses can be maintained or improved by controlling brush, following suitable grazing practices, and protecting the soils from fire.

The shrink-swell potential, low strength, slope, and thickness to bedrock can be overcome by special design where these soils are used for community development. Capability unit VIIs-2; Foraker part in Loamy Prairie range site, Shidler part in Very Shallow range site.

24—Gasil fine sandy loam, 3 to 5 percent slopes. This deep, well drained, gently sloping soil is on side slopes of uplands. Slopes are smooth and convex. Individual areas are 10 to 30 acres.

Typically the surface layer is very dark grayish brown fine sandy loam to a depth of 8 inches. The subsurface layer is brown fine sandy loam to a depth of 14 inches. The upper part of the subsoil is brown, strong brown, and yellowish brown sandy clay loam to a depth of 51 inches. The lower part is sandy clay loam mottled in shades of gray and brown to a depth of 74 inches.

About 15 percent of this mapping unit is included areas of soils that are similar to Gasil soils except that the thickness to bedrock is less than 60 inches, and 5 percent is soils that are similar to Gasil soils except for slight wetness. Also included are inextensive areas of Darnell, Konawa, and Stephenville soils.

This soil has moderate permeability and medium available water capacity. It is used mostly for tame pasture, range, and trees for firewood and posts. It is also suited to grain sorghum, peanuts, small grain, and other crops.

The main concerns of management are controlling erosion and maintaining tilth and fertility. Erosion can be reduced by proper use of crop residue, terraces, and contour farming. Crops that produce large amounts of residue should be managed for soil improvement. Minimum tillage and grasses and legumes in the cropping system reduce runoff and soil erosion. The quality of grasses can be maintained or improved by following suitable grazing practices, protecting the soil from fire, controlling brush, and adding fertilizer where needed.

Low strength can be overcome by special design where this soil is used for community development. Capability Unit IIIe-5, Sandy Savannah range site.

25—Grainola-Shidler complex, 12 to 25 percent slopes. This complex consists of small areas of Grainola and Shidler soils that are so intermingled that they could not be separated at the scale selected for mapping. These soils are on crests and side slopes of uplands. Slopes are smooth and convex. Individual areas of the mapping unit are 20 to 250 acres. Individual areas of each soil are 1 to 15 acres.

The Grainola soil makes up about 55 percent of the mapped acreage. It is a moderately deep, well drained, moderately steep or steep soil in less stony areas between contour bands of Shidler soil. Typically the surface layer is dark reddish brown silty clay loam to a depth of 8 inches. The upper part of the subsoil is reddish brown silty clay loam to a depth of 13 inches. The lower part is dark reddish brown silty clay to a depth of 36 inches. The underlying material is shale bedrock.

This soil has slow permeability and medium available water capacity.

The Shidler soil makes up about 25 percent of the mapped acreage. It is a shallow, well drained, moderately steep soil in more stony bands between areas of Grainola soil. Typically the surface layer is dark brown silty clay loam to a depth of 8 inches. Below this layer is hard limestone bedrock.

This soil has moderate permeability and low available water capacity.

About 10 percent of this in mapping unit is included areas of Corbin soils, 5 percent is Foraker soils, and 5 percent is soils that are similar to Shidler soils except that the surface layer is slightly more clayey or more red.

These soils are used mostly for range. The quality of grasses can be maintained or improved by following suitable grazing practices and protecting the soils from fire.

The shrink-swell potential, low strength, slope, and thickness to bedrock can be overcome by special design where these soils are used for community development. Capability unit VIIs-3; Grainola part in Shallow Prairie range site, Shidler part in Very Shallow range site.

26—Kiomatia loamy fine sand. This deep, well drained, very gently sloping soil is on flood plains. Slopes are convex and concave. Individual areas are 20 to 80 acres.

Typically the surface layer is brown loamy fine sand to a depth of 17 inches. The underlying material is brown loamy fine sand to a depth of 65 inches.

About 20 percent of this mapping unit is included areas of soils that are similar to Kiomatia soils except that the surface layer is slightly darker, 15 percent is soils that are similar to Kiomatia soils except that the underlying material is slightly more clayey, and 5 percent is Choska soils.

This soil is occasionally flooded, and the seasonal water table is 4 to 10 feet below the surface. Permeability is rapid, and available water capacity is low. The soil is used mostly for alfalfa, grain sorghum, small grains, and corn. It is also suited to soybeans, tame pasture grasses, range grasses, peanuts, and trees.

Management is needed to maintain fertility, reduce flooding, and protect the soil from blowing. Soil blowing can be controlled by stripcropping, growing cover crops, and using crop residue. Plant cover is needed in winter and in spring to protect the soil from blowing. Sown crops can be grown continuously if fertilizer is added and crop residue is managed for soil improvement. Crop residue should be returned to the soil and excessive tillage should be avoided. The quality of grasses can be maintained or improved by following suitable grazing practices, controlling brush, adding fertilizer, and protecting the soil from fire.

Flooding can be overcome by special design where this soil is used for recreational development. Capability unit IIIs-2; Sandy Bottomland range site.

27—Kiomatia soils. This mapping unit consists of Kiomatia soils and other soils which are closely associated in an irregular pattern on uneven, low, convex ridges and concave valleys. Individual areas of the soils are large enough to map separately, but because of present and predicted use and response to management, they are not mapped separately. Slopes are nearly level through very gently sloping. Individual areas of the mapping unit are 15 to 45 acres. Individual areas of each soil are 10 to 30 acres.

Kiomatia soils make up about 65 percent of the mapped acreage. The surface layer is variable and includes loamy fine sand, fine sandy loam, very fine sandy loam, and clay loam. Kiomatia soils are deep, well drained, nearly level through very gently sloping soils on flood plains. They are on low ridges. Typically the surface layer is dark grayish brown loamy fine sand to a depth of 16 inches. The underlying material is brown loamy fine sand to a depth of 30 inches and light brown fine sand to a depth of 60 inches.

This soil is frequently flooded, and the seasonal water table is 3 to 5 feet below the surface. Permeability is rapid, and available water capacity is low.

About 15 percent of this mapping unit is included areas of Pursley Variant soils, 10 percent is Choska soils, and 10 percent is soils that are similar to Kiomatia soils except that the underlying material is slightly less sandy. These included soils are frequently flooded and are in slightly lower areas.

The soils in this mapping unit are used for tame pasture, range, and woodland.

Management is needed to maintain fertility, reduce flooding, and protect the soil from blowing. The quality of grasses can be maintained by following suitable grazing practices, adding fertilizer, controlling brush, and protecting the soil from fire.

Flooding can be overcome by special design where this soil is used for recreational development. Capability unit Vw-2; Sandy Bottomland range site.

28—Konawa loamy fine sand, 3 to 8 percent slopes, eroded. This deep, well drained, gently sloping through sloping soil is on side slopes of uplands. Slopes are smooth and convex. Individual areas are 5 to 25 acres.

Typically the surface layer is brown loamy fine sand to a depth of 6 inches. The subsurface layer is brown loamy fine sand to a depth of 15 inches. The upper part of the subsoil is reddish brown sandy clay loam to a depth of 30 inches. The lower part is yellowish red sandy clay loam to a depth of 43 inches. The underlying material is yellowish red loamy fine sand to a depth of 62 inches.

About 15 percent of this mapping unit is included areas of Dougherty soils, and 10 percent is soils that are similar to Konawa soils except that the surface and subsurface layers have been removed by water erosion and the subsoil is exposed. A few noncrossable gullies are present.

This soil has moderate permeability and medium available water capacity. It is used mostly for range and tame pasture. It is also suited to grain sorghum, peanuts, small grains, and other crops.

Management is needed to control erosion and maintain fertility. Erosion can be controlled by growing cover crops, planting on the contour, and properly managing residue. Tilling of the soil should be held to a minimum. Crops and tame pasture grasses need application of fertilizer. The quality of grasses can be maintained or improved by following suitable grazing practices, controlling brush, protecting the soil from fire, and applying needed fertilizer.

These soils are adapted to community development. Where they are used for recreational development, the sandy surface layer and the gullies can be overcome by special design. Capability unit IVe-6; Deep Sand Savannah range site.

29—Lightning silt loam. This deep, somewhat poorly drained, nearly level soil is on flood plains. Slopes are smooth and concave. Individual areas are 10 to 80 acres.

Typically the surface layer is very dark grayish brown silt loam to a depth of 7 inches. The subsurface layer is dark grayish brown silty clay loam to a depth of 10 inches. The upper part of the subsoil is dark grayish brown silty clay loam to a depth of 37 inches and dark grayish brown and dark brown silty clay to a depth of 72 inches.

About 10 percent of this mapping unit is included areas of soils that are similar to Lightning soils except that the upper part of the subsoil has more exchangeable sodium, 5 percent is Osage soils, and 5 percent is Mason soils.

This soil has a seasonal water table at the surface to 2 feet below the surface. Permeability is very slow, and available water capacity is medium. The soil is occasionally flooded. It is used mostly for range and tame pasture. It is also suited to grain sorghum, small grains, soybeans, corn, trees, and other crops.

Concerns of management are controlling flooding, improving surface drainage, and improving or maintaining tilth and fertility. Returning adequate amounts of crop residue and fertilizer to the soil maintains desirable tilth and fertility. Tillage should be timely and kept to a minimum. Tilling or grazing these soils when wet causes excessive compaction. A drainage siphon is needed to remove excess water. The quality of grasses can be main-

tained or improved by following suitable grazing practices, controlling brush, protecting the soil from fire, and applying needed fertilizer.

The slow intake of water and the flooding can be overcome by special design where this soil is used for recreational development. Capability unit IIIw-1; Heavy Bottomland range site.

30—Lula silt loam, 1 to 3 percent slopes. This deep, well drained, very gently sloping soil is on crests of uplands. Slopes are smooth and convex. Individual areas are 40 to 200 acres.

Typically the surface layer is dark brown silt loam to a depth of 10 inches. The upper part of the subsoil is dark reddish brown silty clay loam to a depth of 18 inches. The lower part is reddish brown silty clay loam to a depth of 49 inches. Below this is hard limestone bedrock.

About 20 percent of this mapping unit is included areas of Catoosa soils, and 10 percent is soils that are similar to Lula soils except that thickness to bedrock is more than 60 inches. Inextensive areas of Apperson, Shidler, and Wolco soils are also included.

This soil has moderate permeability and high available water capacity.

The soil is used mostly for range but is also suited to alfalfa, grain sorghum, small grains, tame pasture grasses, corn, soybeans, and other crops.

Management is needed to maintain tilth and fertility and to control erosion. Minimum tillage and the use of cover crops, including grasses and legumes, in the cropping system reduce runoff and control erosion. The tilth and fertility can be maintained by adding crop residue and fertilizer. Erosion is a moderate hazard. The quality of grasses can be maintained or improved by following suitable grazing practices, protecting the soil from fire, and applying needed fertilizer.

Where this soil is used for community development, the shrink-swell and low strength can be overcome by special design. Capability unit IIe-2; Loamy Prairie range site.

31—Mason silt loam, 0 to 1 percent slopes. This deep, well drained to moderately well drained, nearly level soil is on flood plains. Slopes are smooth and convex. Individual areas are 30 to 170 acres.

Typically the surface layer and the next layer are very dark grayish brown silt loam to a depth of 13 inches. The upper part of the subsoil is dark brown silty clay loam to a depth of 21 inches. The lower part is brown silty clay loam to a depth of 96 inches.

About 20 percent of this mapping unit is included areas of soils that are similar to Mason soils except that the subsoil is slightly more clayey, 15 percent is soils that are similar to Mason soils except that the upper part of the subsoil has grayish mottles, and 15 percent is soils that are similar to Mason soils except that the subsoil has reddish colors.

This soil is rarely flooded. Permeability is moderate, and available water capacity is high. The soil is used mostly for small grains, grain sorghum, corn, alfalfa, soybeans, tame pasture grasses, range grasses, and trees.

Management is needed to maintain fertility and tilth. Using crop residue for soil improvement, using legumes and grasses in the cropping system, adding fertilizer, and avoiding excessive tillage are desirable practices.

Flooding can be overcome by special design where this soil is used for recreational development. Capability unit I-1: Loamy Bottomland range site.

32—Mason silt loam, 1 to 3 percent slopes. This deep, well drained to moderately well drained, very gently sloping soil is on flood plains. Slopes are smooth and convex. Individual areas are 5 to 25 acres.

Typically the surface layer is very dark grayish brown silt loam to a depth of 8 inches. The upper part of the subsoil is dark brown silty clay loam to a depth of 16 inches. The lower part is brown silty clay loam to a depth of 60 inches.

About 40 percent of this mapping unit is included areas of soils that are similar to Mason soils except that they are steeper and that the subsoil is slightly less clayey, 15 percent is soils that are similar to Mason soils except that the dark colored layers are slightly less thick in the upper part of the soil, and 5 percent is soils that are similar to Mason soils except that the upper part of the subsoil has grayish mottles.

This soil is rarely flooded. Permeability is moderately slow, and available water capacity is high. The soil is used mostly for tame pasture. It is also suited to alfalfa, grain sorghum, small grains, corn, soybeans, range grasses, trees, and other crops.

Management is needed to control erosion and to maintain tilth and fertility. Using crop residue for soil improvement, using grasses and legumes in the cropping system, adding fertilizer, and avoiding excessive tillage are desirable practices. The quality of grasses can be maintained or improved by following suitable grazing practices, controlling brush, protecting the soil from fire, and applying needed fertilizer.

Flooding can be overcome by special design where these soils are used for recreational development. Capability unit IIe-2; Loamy Bottomland range site.

33—Mason-Drummond complex, 0 to 1 percent slopes. This complex consists of small areas of Mason and Drummond soils that are so intermingled that they could not be separated at the scale selected for mapping (fig. 5). These soils are on flood plains. Individual areas of the mapping unit are 5 to 40 acres. Individual areas of each soil are 1 to 15 acres.

Mason soil makes up about 30 percent of the mapped acreage. It is a deep, well drained to moderately well drained, nearly level soil. It is on slightly higher, convex parts of the landscape. Typically the surface layer is very dark brown silt loam to a depth of 12 inches. The upper part of the subsoil is very dark brown silty clay loam to a depth of 21 inches. The middle part is very dark grayish brown silty clay loam to a depth of 57 inches. The lower part is dark brown silty clay loam to a depth of 86 inches.

This soil is rarely flooded. Permeability is moderately slow, and available water capacity is high.

Drummond soil makes up 25 percent of the mapped acreage. It is a deep, somewhat poorly drained, nearly level soil. It is on the slightly lower, concave parts of the landscape. Typically the surface layer is dark grayish brown silt loam to a depth of 5 inches. The upper part of the subsoil is very dark gray silty clay to a depth of 17 inches, very dark grayish brown silty clay to a depth of 31 inches, and dark grayish brown silty clay to a depth of 43 inches. The lower part is dark brown silty clay to a depth of 80 inches.

This soil has a seasonal water table 2 to 6 feet below the surface and excessive amounts of exchangeable sodium in the upper part of the subsoil. It is rarely flooded. Permeability is very slow and available water capacity is low.

About 30 percent of this mapping unit is included areas of soils that are similar to Mason and Drummond soils except that they are gradational in development between these soils, 5 percent is Osage soils, 5 percent is Verdigris soils, and 5 percent is Wynona soils. Inextensive areas of Cleora and Barnsdall soils are also included.

These soils are used mostly for tame pasture and range. They are also suited to alfalfa, grain sorghum, small grains, soybeans, trees, and other crops.

Maintaining soil tilth and fertility, improving surface drainage, and overcoming high exchangeable sodium are the main concerns of management. Using crop resudue for soil improvement, avoiding tilling the soil when wet, applying fertilizer and gypsum, and installing drainage systems are desirable practices. The quality of grasses can be maintained or improved by following suitable grazing practices, controlling brush, protecting the soils from fire, and applying needed fertilizer.

Flooding, slow water intake, wetness, and high exchangeable sodium can be overcome by special design where these soils are used for recreational development. Capability unit IIIs-1; Mason part in Loamy Bottomland range site, Drummond part in Alkali Bottomland range site.

34—Minco silt loam, 5 to 8 percent slopes. This deep, well drained, sloping soil is on side slopes of uplands. Slopes are smooth and convex. Individual areas are 15 to 50 acres.

Typically the surface layer is dark brown silt loam to a depth of 10 inches. The next layer is dark brown silt loam to a depth of 19 inches. The subsoil is reddish brown silt loam to a depth of 38 inches. The underlying material is yellowish red silt loam to a depth of 62 inches.

About 10 percent of this mapping unit is included areas of soils that are similar to Minco soils except that the surface layer and the next layers are thinner, 5 percent is Norge soils, and 5 percent is Teller soils.

This soil has moderate permeability and high available water capacity. It is used mostly for tame pasture and range. It is also suited to small grains and other crops.

Management is needed to control erosion and maintain fertility and structure. The very severe hazard of erosion can be controlled by terracing, contour farming, strip-cropping, and using high-residue crops in the cropping system. Using crop residue and fertilizer helps maintain soil tilth and fertility. The quality of grasses can be maintained or improved by following suitable grazing practices, controlling brush, protecting the soil from fire, and applying needed fertilizer.

The low strength can be overcome by special design where this soil is used for community development. Capability unit IVe-2; Loamy Prairie range site.

35—Niotaze-Darnell complex, 3 to 15 percent slopes. This complex consists of small areas of Niotaze and Darnell soils that are so intermingled that they could not be separated at the scale selected for mapping. These soils are on crests and side slopes of uplands. Individual areas of the mapping unit are 50 to 500 acres. Individual areas of each soil are 5 to 20 acres.

Niotaze soil makes up about 65 percent of the mapped acreage. It is a moderately deep, somewhat poorly drained, very gently sloping through moderately steep soil. It is in less stony, more sloping areas between bands of Darnell soils. Typically the surface layer is very dark grayish brown silt loam to a depth of 3 inches (fig. 6). The subsurface layer is brown silt loam to a depth of 6 inches. The upper part of the subsoil is reddish brown silty clay to a depth of 15 inches. The middle part is mottled in shades of red, brown, and olive silty clay to a depth of 28 inches. The lower part is olive silty clay to a depth of 36 inches. The underlying material is shale bedrock.

This soil has a seasonal water table 1 1/2 to 2 1/2 feet below the surface. Permeability is slow, and available water capacity is medium.

Darnell soil makes up 15 percent of the mapped acreage. It is a shallow, well drained to somewhat excessively drained, very gently sloping through strongly sloping soil. It is in more stony, narrow contour bands between areas of Niotaze soil. Typically the surface layer is very dark grayish brown fine sandy loam to a depth of 4 inches. The subsoil is brown fine sandy loam to a depth of 13 inches. The underlying material is sandstone bedrock.

This soil has moderately rapid permeability and low available water capacity.

About 10 percent of this mapping unit is included areas of soils that are similar to Darnell soils except that the thickness to sandstone bedrock is less than 10 inches, 5 percent is soils that are similar to Niotaze soils except that the thickness to shale bedrock is more than 40 inches, and 5 percent is Steedman soils. Inextensive areas of Coweta soils and sandstone bedrock exposed at the surface are also included.

These soils are used mostly for range. The smoother, less stony areas are also suited to tame pasture grasses. These soils are also suited to trees for firewood and posts.

The quality of grasses can be maintained or improved by following suitable grazing practices, controlling brush, protecting the soils from fire, and applying fertilizer where needed.

The thickness to bedrock, wetness, shrink-swell potential, and low strength can be overcome by special design where these soils are used for community development. Capability unit VIIs-5; Niotaze part in Sandy Savannah range site, Darnell part in Shallow Savannah range site.

36—Niotaze-Darnell complex, 15 to 25 percent slopes. This complex consists of small areas of Niotaze and Darnell soils that are so intermingled that they could not be separated at the scale selected for mapping. These soils are on crests and side slopes of uplands. Individual areas of the mapping unit are 20 to 100 acres. Individual areas of each soil are 5 to 20 acres.

The Niotaze soil makes up about 60 percent of the mapped acreage. It is a moderately deep, somewhat poorly drained, moderately steep or steep soil. It is in less stony, more sloping areas between bands of Darnell soil. Typically the surface layer is very dark brown loam to a depth of 3 inches. The subsurface layer is brown loam to a depth of 9 inches. The upper part of the subsoil is yellowish red silty clay to a depth of 28 inches. The lower part is silty clay mottled in shades of red, brown, and gray to a depth of 32 inches. The underlying material is shale bedrock.

This soil has a seasonal water table 1 1/2 to 2 1/2 feet below the surface. Permeability is slow, and available water capacity is medium.

The Darnell soil makes up 15 percent of the mapped acreage. It is a shallow, well drained to somewhat excessively drained, moderately steep soil. It is on more stony, narrow contour bands between areas of Niotaze soil. Typically the surface layer is very dark grayish brown fine sandy loam to a depth of 3 inches. The subsoil is brown fine sandy loam to a depth of 12 inches. The underlying material is sandstone bedrock.

This soil has moderately rapid permeability and low available water capacity.

About 15 percent of this mapping unit is included areas of soils that are similar to Niotaze soils except that the thickness to shale is more than 40 inches, and 10 percent is soils that are similar to Darnell soils except that the thickness to sandstone is less than 10 inches. Inextensive areas of soils in which sandstone bedrock is exposed at the surface, and Foraker and Shidler soils are also included.

These soils are used mostly for range. They are also suited to trees for firewood and posts.

The quality of grasses can be maintained or improved by following suitable grazing practices, controlling brush, and protecting the soils from fire.

The thickness to bedrock, wetness, shrink-swell potential, low strength, and slope can be overcome by special design where these soils are used for community development. Capability unit VIIs-5; Niotaze part in Sandy Savannah range site, Darnell part in Shallow Savannah range site.

37—Niotaze-Darnell complex, 25 to 45 percent slopes. This complex consists of small areas of Niotaze and Darnell soils that are so intermingled that they could not be separated at the scale selected for mapping. These are on crests and side slopes of uplands. Individual areas of the mapping unit are 15 to 70 acres. Individual areas of each soil are 5 to 20 acres.

The Niotaze soil makes up about 35 percent of the mapped acreage. It is a moderately deep, somewhat poorly drained, steeply sloping soil. It is in the more sloping areas between bands of Darnell soil. Typically the surface layer is very dark grayish brown loam to a depth of 2 inches. The subsurface layer is brown loam to a depth of 7 inches. The upper part of the subsoil is light olive brown silty clay to a depth of 20 inches. The lower part is silty clay mottled in shades of olive, brown, and gray to a depth of 30 inches. The underlying material is shale bedrock.

This soil has a seasonal water table 1 1/2 to 2 1/2 feet below the surface. Permeability is slow, and available water capacity is medium.

The Darnell soil makes up about 20 percent of the mapped acreage. It is a shallow, well drained to somewhat excessively drained, steeply sloping soil. It is in more stony, narrow contour bands between areas of Niotaze soil. Typically the surface layer is very dark grayish brown fine sandy loam to a depth of 3 inches. The subsoil is brown fine sandy loam to a depth of 11 inches. The underlying material is sandstone bedrock.

This soil has moderately rapid permeability and low available water capacity.

About 30 percent of this mapping unit is included areas of soils that are similar to Niotaze soils except that the thickness to shale bedrock is more than 40 inches, and 15 percent is soils that are similar to Darnell soils except that the thickness to sandstone bedrock is less than 10 inches. Inextensive areas of soils in which sandstone bedrock is exposed at the surface, and Stephenville, Foraker, Shidler, and Coweta soils are also included.

These soils are used mostly for range. They are also suited to trees for firewood and posts.

The quality of grasses can be maintained or improved by following suitable grazing practices, controlling brush, and protecting the soils from fire.

Thickness to bedrock, wetness, shrink-swell potential, low stength, and slope can be overcome by special design where these soils are used for community development. Capability unit VIIs-6; Savannah Breaks range site.

38—Norge silt loam, 1 to 3 percent slopes. This deep, well drained, very gently sloping soil is on crests and side slopes of uplands. Slopes are smooth and convex. Individual areas are 10 to 80 acres.

Typically the surface layer is dark brown silt loam to a depth of 10 inches. The upper part of the subsoil is dark reddish brown silty clay loam to a depth of 17 inches and reddish brown silty clay loam to a depth of 49 inches. The lower part is yellowish red silty clay loam to a depth of 74 inches.

About 10 percent of this mapping unit is included areas of Teller soils, 15 percent is Corbin soils, and 5 percent is Vanoss soils. Inextensive areas of Stoneburg soils are also included.

This soil has moderately slow permeability and high available water capacity. It is used mostly for tame pasture. It is also suited to alfalfa, grain sorghum, small grains, range grasses, soybeans, corn, and other crops.

Management is needed to protect the soil from erosion and to maintain fertility and tilth. The erosion hazard can be reduced by terracing, contour farming, and using crop residue. Crop residue should be returned to the soil, fertilizer should be added, and excessive tillage should be avoided. The quality of grasses can be maintained or improved by following suitable grazing practics, protecting the soil from fire, and applying fertilizer where needed.

The low strength and shrink-swell potential can be overcome by special design where this soil is used for community development. Capability unit IIe-2; Loamy Prairie range site.

39—Norge silt loam, 3 to 5 percent slopes. This deep, well drained, gently sloping soil is on side slopes of uplands. Slopes are smooth and convex. Individual areas are 20 to 150 acres.

Typically the surface layer is dark brown silt loam to a depth of 8 inches. The upper part of the subsoil is dark reddish brown silty clay loam to a depth of 13 inches and reddish brown silty clay loam to a depth of 48 inches. The lower part is yellowish red silty clay loam to a depth of 72 inches.

About 10 percent of this mapping unit is included areas of Teller soils, 5 percent is Minco soils, and 5 percent is Vanoss soils. Also included are inextensive areas of Corbin and Stoneburg soils.

This soil has moderately slow permeability and high available water capacity. It is used mostly for tame pasture. It is also suited to grain sorghum, corn, small grains, soybeans, range grasses, and other crops.

The main concerns of management are the severe hazard of erosion and the maintenance of soil tilth and fertility. The hazard of erosion can be reduced by using crop residue properly, terracing, and contour farming. Crops that produce large amounts of residue should be managed for soil improvement. Minimum tillage and grasses and legumes in the cropping system are desirable practices. The quality of grasses can be maintained or improved by following suitable grazing practices, protecting the soil from fire, and applying fertilizer where needed.

The low strength and shrink-swell potential can be overcome by special design where this soil is used for community development. Capability unit IIIe-3; Loamy Prairie range site.

40—Norge silt loam, 5 to 8 percent slopes. This deep, well drained, sloping soil is on side slopes of uplands. Slopes are smooth and convex. Individual areas are 10 to 40 acres.

Typically the surface layer is dark brown silt loam to a depth of 8 inches. The upper part of the subsoil is dark reddish brown silty clay loam to a depth of 13 inches. The lower part is reddish brown silty clay loam to a depth of 62 inches.

About 10 percent of this mapping unit is included areas of Teller soils, and 30 percent is soils that are similar to Norge soils except that the dark colored surface layer is thinner. Inextensive areas of Minco soils and inextensive areas of a soil that is similar to Norge soils except that thickness to bedrock is less than 60 inches are also included.

This soil has moderately slow permeability and high available water capacity. It is used mostly for tame pasture, hay meadows, and range. It is also suited to small grains and other crops.

Management is needed to control erosion and to maintain fertility and tilth. The very severe erosion hazard can be controlled by terracing, contour farming, striperopping, and using high residue producing crops in the cropping system. Using crop residue and fertilizer helps maintain soil tilth and fertility. The quality of grasses can be maintained or improved by following suitable grazing practices, protecting the soil from fire, and adding fertilizer where needed.

The low strength and shrink-swell potential can be overcome by special design where this soil is used for community development. Capability unit IVe-2; Loamy Prairie range site.

41—Norge silt loam, 2 to 5 percent slopes, eroded. This deep, well drained, very gently sloping through gently sloping, eroded soil is on side slopes of uplands. Slopes are smooth and convex. Individual areas are 15 to 60 acres.

Typically the surface layer is dark brown silt loam to a depth of 8 inches. The upper part of the subsoil is dark reddish brown silty clay loam to a depth of 11 inches and reddish brown silty clay loam to a depth of 41 inches. The lower part is yellowish red silty clay loam to a depth of 72 inches.

About 10 percent of this mapping unit is included areas of Teller soils, 5 percent is Stoneburg soils, and 25 percent is soils that are similar to Norge soils except that the surface layer has been thinned by erosion and that a few shallow gullies are present in some areas.

This soil has moderately slow permeability and high available water capacity. It is used mostly for tame pasture. It is also suited to grain sorghum, soybeans, small grains, range grasses, and other crops.

The main concerns of management are the severe hazard of erosion and the maintenance of soil tilth and fertility. The hazard of erosion can be reduced by seeding grasses or, in cultivated areas, by using crop residue properly, terracing, and contour farming. Crops that produce large amounts of residue should be managed for soil improvement. Minimum tillage and grasses and legumes in the cropping system are desirable practices. The quality of grasses can be maintained or improved by following suitable grazing practices, protecting the soil from fire, and applying fertilizer where needed.

The low strength and shrink-swell potential can be overcome by special design where this soil is used for community development. Capability unit IIIe-4; Loamy Prairie range site.

42—Norge, Dennis, and Prue soils, gullied. This mappping unit consists of very gently sloping through sloping, gullied soils on uplands (fig. 7). It consists primarily of Norge, Dennis, and Prue soils in an irregular pattern between gullies. Individual areas of these soils are large enough to map separately, but because of present use, predicted use, and similar response to use and management, they were not separated in mapping. Individual areas are 5 to 60 acres.

This mapping unit is about 20 percent Norge soils, 20 percent Dennis soils, 15 percent Prue soils, and 10 percent gullies and soils that are similar to Norge, Dennis, or Prue soils except that the surface layer has been removed and the subsoil is exposed. The rest consists of Bates, Corbin, Dougherty, Minco, Parsons, Pawhuska, and Teller soils between gullies. The gullies are 50 to 150 feet apart, 2 to 50 feet wide, and 2 to 30 feet deep.

Norge soil is a deep, well drained, moderately slowly permeable, very gently sloping through sloping soil on side slopes. It has high available water capacity. Typically the surface layer is dark brown silt loam to a depth of 6 inches. The upper part of the subsoil is dark reddish brown silty clay loam to a depth of 11 inches and reddish brown silty clay loam to a depth of 22 inches. The lower part is yellowish red silty clay loam to a depth of 72 inches.

Dennis soil is a deep, moderately well drained, slowly permeable, very gently sloping or gently sloping soil. It has a seasonal water table 2 to 3 feet below the surface. Available water capacity is high. Typically the surface layer is very dark grayish brown silt loam to a depth of 13 inches. The upper part of the subsoil is very dark grayish brown silty clay loam to a depth of 18 inches and brown silty clay loam to a depth 29 inches. The lower part is brown silty clay to a depth of 72 inches.

Prue soil is a deep, moderately well drained, moderately slowly permeable, gently sloping soil. It has high available water capacity. Typically the surface layer is very dark brown loam to a depth of 13 inches. The upper part of the subsoil is very dark grayish brown loam to a depth of 20 inches. The middle part is brown sandy clay loam to a depth of 30 inches and yellowish brown sandy clay loam to a depth of 42 inches. The lower part is silty clay loam mottled in shades of brown, red, and gray to a depth of 72 inches.

These gullied soils are used for tame pasture and range. The main concerns of management are the very severe erosion hazard and the reseeding of these soils to permanent vegetation. Addition of fertilizer, diversion of overhead water, and stabilization of gullies are desirable practices. The quality of grasses can be maintained or improved by following suitable grazing practices, protecting the soil from fire, controlling brush, and applying fertilizer where needed.

The shrink-swell potential, low strength, wetness, and gullies can be overcome by special design where these soils are used for community development. Capability unit VIe-2; Eroded Prairie range site.

43—Norge-Pawhuska complex, 1 to 5 percent slopes. This complex consists of small areas of Norge and Pawhuska soils that are so intermingled that they could not be separated at the scale selected for mapping. These soils are on crests and side slopes of uplands. Individual areas of the mapping unit are 20 to 200 acres. Individual areas of each soil are 1 to 15 acres.

The Norge soil makes up about 35 percent of the mapped acreage. It is a deep, well drained, very gently sloping through sloping soil. It is on the slightly higher, convex parts of the landscape. Typically the surface layer is dark brown silt loam to a depth of 10 inches. The upper part of the subsoil is dark reddish brown silty clay loam to a depth of 15 inches and reddish brown silty clay loam to a depth of 28 inches. The lower part is yellowish red silty clay loam to a depth of 72 inches.

This soil has moderately slow permeability and high available water capacity.

The Pawhuska soil makes up 20 percent of the mapped acreage. It is a deep, moderately well drained, very gently sloping through gently sloping soil. It is on slightly lower, concave parts of the landscape. Typically the surface layer is very dark grayish brown silt loam to a depth of 8 inches. The upper part of the subsoil is a very dark grayish brown silty clay to a depth of 16 inches and dark grayish brown silty clay to a depth of 32 inches. The lower part is brown silty clay to a depth of 56 inches and reddish brown silty clay loam to a depth of 72 inches.

This soil has excessive amounts of exchangeable sodium in the upper part of the subsoil. Permeability is very slow, and available water capacity is low.

About 30 percent of this mapping unit is included areas of soils that are similar to Pawhuska soils except that the upper part of the subsoil has slightly less amounts of exchangeable sodium, 5 percent is Corbin soils, 5 percent is Stoneburg soils, and 5 percent is Teller soils. Inextensive areas of Vanoss soils are also included.

These soils are used mostly for tame pasture. They are also suited to range grasses, small grains, soybeans, and other crops.

Management is needed to maintain tilth and fertility, reduce surface crusting, and control erosion. Returning adequate amounts of crop residue and fertilizer to these soils are desirable practices. Tilling or grazing when wet causes excessive compaction. The quality of grasses can be maintained or improved by following suitable grazing practices, protecting the soil from fire, and adding fertilizer where needed.

The shrink-swell potential, high exchangeable sodium content, and low strength can be overcome by special design where these soils are used for community development. Capability unit IVs-1; Norge part in Loamy Prairie range site; Pawhuska part in Shallow Claypan range site.

44—Oil-waste land. This miscellaneous area consists of areas where oil and salt water have accumulated in pits or flowed over soils of uplands and flood plains. Individual areas are 10 to 150 acres. The slopes range from nearly level through steeply sloping.

Oil-waste land is variable in thickness to bedrock. The soil material is loamy or clayey. It has been damaged by oil and salt water to the extent that it takes in water very slowly. The erosion hazard is very severe, and very little vegetation grows on these areas.

Management is needed to leach the oil and salt from the soil where it is nearly level through very gently sloping so that vegetation can be established. Where practical, water from higher lying areas should be diverted. The application of gypsum, hay, straw, or manure and the impoundment of water where the soil is less sloping help in the reclamation of this soil material. Not assigned to a capability unit or a range site.

45—Okemah silt loam, 0 to 2 percent slopes. This deep, moderately well drained, nearly level through very gently sloping soil is on valleys of uplands. Slopes are smooth and concave. Individual areas are 25 to 70 acres.

Typically the surface layer and the next layer are black silt loam to a depth of 15 inches. The upper part of the subsoil is very dark gray silty clay loam to a depth of 21 inches and very dark grayish brown silty clay to a depth of 50 inches. The lower part is silty clay mottled in shades of brown and gray to a depth of 71 inches.

About 25 percent of this mapping unit is included areas of soils that are similar to Okemah soils except that the thickness to bedrock is slightly less than 60 inches, 10 percent is soils that are similar to Okemah soils except that the subsoil is more red, 5 percent is Dennis soils, and 5 percent is Parsons soils. Inextensive areas of Pawhuska soils are also included.

This soil has a seasonal water table 2 to 3 feet below the surface. Permeability is slow, and available water capacity is high. The soil is used mostly for hay meadows and range. It is also suited to alfalfa, grain sorghum, small grains, tame pasture grasses, corn, soybeans, and other crops.

Management is needed to maintain tilth and fertility and to control erosion. Minimum tillage and the use of cover crops, including grasses and legumes, in the cropping system help reduce runoff and control erosion. The tilth and fertility can be maintained by adding crop residue and fertilizer to the soil. Erosion is a moderate hazard. The quality of grasses can be maintained or improved by using suitable grazing practices, protecting the soil from fire, and adding fertilizer where needed.

The shrink-swell potential, low strength, and wetness can be overcome by special design where this soil is used for community development. Capability unit IIe-1; Loamy Prairie range site.

46—Osage silty clay. This deep, poorly drained, nearly level soil is on flood plains. Slopes are smooth and concave. Individual areas are 20 to 120 acres.

Typically the surface layer is very dark gray silty clay to a depth of 8 inches. The next layer is black silty clay to a depth of 16 inches. The upper part of the subsoil is very dark gray silty clay to a depth of 38 inches. The lower part is dark grayish brown sitly clay to a depth of 72 inches.

About 5 percent of this mapping unit is included areas of Lightning soils, and 5 percent is Wynona soils.

This soil has a seasonal water table at the surface to 1 foot below the surface. It is occasionally flooded. Permeability is very slow, and available water capacity is medium. The soil is used mostly for wheat. It is also suited to other small grains, range grasses and tame pasture grasses, trees, alfalfa, grain sorghum, corn, soybeans, and other crops.

Management is needed to control wetness, maintain tilth and fertility, and protect the soil from flooding. Surface drainage is generally sufficient to control wetness. Diversion terraces are needed in some areas to divert runoff from higher lying soils. Crop residue should be returned to the soil and fertilizer added to maintain tilth and fertility.

The flooding, clayey surface layer, wetness, and water intake rates can be overcome by special design where the soil is used for recreation. Capability unit IIIw-1; Heavy Bottomland range site.

47—Parsons silt loam, 0 to 1 percent slopes. This deep, somewhat poorly drained, nearly level soil is in valleys of uplands. Slopes are smooth and concave. Individual areas are 10 to 40 acres.

Typically the surface layer is very dark grayish brown silt loam to a depth of 9 inches. The subsurface layer is dark grayish brown silt loam to a depth of 12 inches. The upper part of the subsoil is very dark grayish brown silty clay to a depth of 20 inches, brown silty clay to a depth of 28 inches, and grayish brown silty clay to a depth of 34 inches. The lower part is silty clay mottled in shades of brown and gray to a depth of 76 inches. The underlying material is shale bedrock.

About 10 percent of this mapping unit is included areas of soils that are similar to Parsons soils except that they are less than 60 inches thick over bedrock, 10 percent is soils that are similar to Parsons soils except that the surface layer is lighter in color, and 5 percent is soils that are similar to Parsons soils except that the combined thickness of the surface and subsurface layers is more than 16 inches. Inextensive areas of Okemah and Pawhuska soils are also included.

This soil has a seasonal water table 1/2 foot to 1 1/2 feet below the surface. Permeability is very slow, and available water capacity is medium. The soil is used mostly for range, tame pasture, and hay meadow. It is also suited to grain sorghum, small grains, corn, soybeans, and other crops.

Management is needed to maintain soil tilth and fertility, reduce surface crusting, and control wetness. Surface drainage is generally sufficient to control wetness. A cropping system is needed to provide crops that produce large amounts of residue, which can be returned to the soil to improve tilth and reduce surface crusting. The quality of grasses can be maintained or improved by using suitable grazing practices, protecting the soil from fire, and adding fertilizer where needed.

The shrink-swell potential, low strength, and wetness can be overcome by special design where the soil is used for community development. Capability unit IIs-1; Claypan Prairie range site.

48—**Parsons silt loam, 1 to 3 percent slopes.** This deep, somewhat poorly drained, very gently sloping soil is in valleys of uplands. Slopes are smooth and convex. Individual areas are 10 to 30 acres.

Typically the surface layer is very dark grayish brown silt loam to a depth of 9 inches. The subsurface layer is dark grayish brown silt loam to a depth of 12 inches. The upper part of the subsoil is very dark grayish brown silty clay to a depth of 20 inches and dark grayish silty clay to a depth of 32 inches. The lower part is silty clay mottled in shades of brown and gray to a depth of 70 inches. The underlying material is shale bedrock.

About 15 percent of this mapping unit is included areas of soils that are similar to Parsons soils except that thickness to bedrock is less than 60 inches, 10 percent is soils that are similar to Parsons soils except that the surface layer is lighter in color, and 5 percent is soils that are similar to Parsons soils except that the combined thickness of the surface and subsurface layers is more than 16 inches. Inextensive areas of Dennis, Okemah, Pawhuska, and Summit soils are also included.

This soil has a seasonal water table 1/2 foot to 1 1/2 feet below the surface. Permeability is very slow, and available water capacity is medium. The soil is used mostly for range, tame pasture, and hay meadows. It is also suited to grain sorghum, small grains, corn, soybeans, and other crops.

Management is needed to maintain fertility and tilth, control erosion, and reduce surface crusting. A cropping system is needed to provide crops that produce large amounts of residue, which can be returned to the soil to improve soil tilth, reduce surface crusting, and control erosion. Terracing and contour tillage are needed where row crops are grown. Sown crops can be grown year after year where fertilizer is added and crop residue is returned to the soil. The quality of grasses can be maintained or improved by using suitable grazing practices, protecting the soil from fire, and adding fertilizer where needed.

The shrink-swell potential, low strength, and wetness can be overcome by special design where this soil is used for community development. Capability unit IIIe-1; Claypan Prairie range site.

49—**Parsons-Carytown complex, 0 to 3 percent slopes.** This complex consists of small areas of Parsons and Carytown soils that are so intermingled that they could not be separated at the scale selected for mapping. These soils are in valleys of uplands. Individual areas of the mapping unit are 15 to 80 acres. Individual areas of each soil are 1 to 15 acres.

Parsons soil makes up about 45 percent of the mapped acreage. It is a deep, somewhat poorly drained, nearly level through very gently sloping soil. It is on slightly higher parts of the landscape. Typically the surface layer is very dark grayish brown silt loam to a depth of 10 inches. The subsurface layer is dark grayish brown silt loam to a depth of 13 inches. The upper part of the subsoil is very dark grayish brown silty clay to a depth of 32 inches. The lower part is silty clay mottled in shades of gray and brown to a depth of 62 inches. The underlying material is shale bedrock.

This soil has a seasonal water table 1/2 foot to 1 1/2 feet below the surface. Permeability is very slow, and available water capacity is medium.

Carytown soil makes up about 35 percent of the mapped acreage. It is a deep, poorly drained, nearly level or very gently sloping soil. It is on slightly lower, concave parts of the landscape. Typically the surface layer is very dark grayish brown silt loam to a depth of 6 inches. The upper part of the subsoil is very dark grayish brown silty clay to a depth of 27 inches. The lower part is silty clay coarsely mottled in shades of gray and brown to a depth of 46 inches. The underlying material is shale bedrock to a depth of 60 inches.

This soil has a seasonal water table at the surface to 1 foot below the surface. It has excessive amounts of exchangeable sodium in the upper part of the subsoil. Permeability is very slow, and available water capacity is low.

About 10 percent of this mapping unit is included areas of soils that are similar to Parsons soils except that thickness to bedrock is less than 60 inches, 5 percent is Okemah soils, and 5 percent is soils that are similar to Parsons soils except that the combined thickness of the surface and subsurface layers is more than 16 inches. Inextensive areas of Bates, Dennis, Lula, and Summit soils are also included.

These soils are used mostly for range and tame pasture. They are also suited to grain sorghum, small grains, soybeans, and other crops.

Management is needed to maintain soil tilth and fertility, reduce surface crusting, and control erosion. Returning adequate amounts of crop residue and fertilizer to these soils reduces surface crusting, helps control erosion, and helps maintain fertility. Tillage should be timely and kept to a minimum. Tilling or grazing these soils when wet causes excessive compaction. The quality of grasses can be maintained or improved by following suitable grazing practices, protecting from the soil fire, and applying needed fertilizer.

The shrink-swell potential, low strength, wetness, and high exchangeable sodium can be overcome by special design where these soils are used for community development. Capability unit IVs-1; Parsons part in Claypan Prairie range site, Carytown part in Shallow Claypan range site.

50—**Pits.** This miscellaneous area consists of areas where soils, limestone, and shale have been excavated, leaving pits. Individual areas are 10 to 50 acres. Most of the pits hold water for long periods. The side slopes support a sparse stand of grasses in some areas.

The side slopes and bottoms of the pits range from bedrock to loamy and clayey materials. Management is needed to establish vegetation for erosion control. Not assigned to a capability unit or a range site.

51—Prue loam, 3 to 5 percent slopes. This deep, moderately well drained, gently sloping soil is on side slopes of uplands. Slopes are smooth and convex. Individual areas are 15 to 50 acres.

Typically the surface layer is very dark brown loam to a depth of 12 inches. The upper part of the subsoil is very dark grayish brown loam to a depth of 18 inches. The middle part is yellowish brown sandy clay loam to a depth of 30 inches and yellowish brown clay loam to a depth of 39 inches. The lower part is silty clay loam mottled in shades of brown and red to a depth of 50 inches and silty clay mottled in shades of brown and gray to a depth of 72 inches. The underlying material is shale bedrock.

About 15 percent of this mapping unit is included areas of soils that are similar to Prue soils except that the thickness to bedrock is 40 to 60 inches, 5 percent is Bates soils, and 5 percent is Dennis soils. Inextensive areas of Coweta and Steedman soils are also included.

This soil has moderately slow permeability and high available water capacity. It is used mostly for tame pasture and range. It is also suited to grain sorghum, small grains, soybeans, corn, and other crops.

Management is needed to maintain fertility and tilth and to protect the soil from erosion. The erosion hazard can be reduced by terracing, contour farming, and using crop residue. Terracing, contour farming, and adding fertilizer and crop residue are needed to conserve moisture and maintain fertility and tilth. The quality of grasses can be maintained or improved by followng suitable grazing practices, protecting the soil from fire, and adding fertilizer where needed.

The shrink-swell potential and low strength can be overcome by special design where this soil is used for community development. Capability unit IIIe-3; Loamy Prairie range site.

52—Pursley Variant fine sandy loam. This deep, well drained to somewhat excessively drained, nearly level through very gently sloping soil is on flood plains. Slopes are slightly concave and convex. Individual areas are 40 to 120 acres.

Typically the surface layer is very dark grayish brown fine sandy loam to a depth of 6 inches. The next layer is very dark grayish brown loam to a depth of 14 inches. The underlying material is dark brown loamy fine sand to a depth of 24 inches and brown fine sand to a depth of 60 inches.

About 20 percent of this mapping unit is included areas of Kiomatia soils, 15 percent is soils that are similar to Pursley Variant soils except that the underlying material is slightly more clayey, and 10 percent is soils that are similar to Pursley Variant soils except that the underlying material is slightly more sandy.

This soil has moderately rapid permeability and low available water capacity. It is subject to occasional flooding. It is used mostly for alfalfa, grain sorghum, small grains, and soybeans. It is also suited to tame pasture grasses, range grasses, corn, peanuts, soybeans, and other crops.

Management is needed to protect this soil from flooding and to maintain soil tilth and fertility. The soil tilth and fertility can be maintained by returning adequate amounts of crop residue and fertilizer to the soil. The quality of grasses can be maintained or improved by following suitable grazing practices, protecting the soil from fire, and applying needed fertilizer.

Flooding can be overcome by special design where this soil is used for sanitary facilities, community development, or recreation. Capability unit IIw-2; Loamy Bottomland range site.

53—Roebuck silty clay loam. This deep, somewhat poorly drained, nearly level soil is on flood plains. Slopes are smooth and concave. Individual areas are 10 to 40 acres.

Typically the surface layer and the next layer are very dark grayish brown silty clay loam to a depth of 11 inches. The upper part of the subsoil is reddish brown silty clay to a depth of 21 inches and dark brown silty clay to a depth of 27 inches. The lower part is very dark grayish brown silty clay loam to a depth of 38 inches and brown clay loam to a depth of 52 inches. The underlying material is brown sandy clay loam to a depth of 60 inches.

About 45 percent of this mapping unit is included areas of soils that are similar to Roebuck soils except that the upper part of the subsoil is browner. Also included are inextensive areas of Mason soils.

This soil has a seasonal water table 2 to 3 feet below the surface. Permeability is very slow, and available water capacity is medium. This soil is used mostly for alfalfa, grain sorghum, small grains, and soybeans. It is also suited to tame pasture grasses, corn, range grasses, trees, and other crops.

Management is needed to control wetness and flooding and to maintain tilth and fertility. Surface drainage is generally sufficient to control wetness. Diversion terraces are needed in some areas to divert runoff from uplands. Crop residue and fertilizer should be returned to the soil to maintain fertility and tilth.

The flooding, clayey surface, wetness, and water intake rates can be overcome by special design where this soil is used for recreational development. Capability unit IIIw-1, Heavy Bottomland range site.

54—Shidler soils, 1 to 5 percent slopes. This mapping unit consists of about 75 percent Shidler soils. The rest is small areas of soils that are similar to Shidler soils except that the surface layer is more than 35 percent, by volume, limestone fragments; small areas of soils that are similar to Shidler soils except that they are slightly more clayey; and small areas of limestone bedrock exposed at the surface. Individual soil areas are 15 to 300 acres.

Typically the surface layer of Shidler soils is very dark brown silty clay loam to a depth of 7 inches (fig. 8). Below this is hard limestone bedrock.

The Shidler soils are shallow, well drained, very gently sloping through gently sloping soils on uplands. They are on convex crests. Permeability is moderate, and available water capacity is low.

These soils are used for range. They are also suited to tame pasture grasses. The limestone is mined for gravel, agricultural lime, and other uses. The quality of grasses can be maintained or improved by following suitable grazing practices and protecting the soil from fire.

The thickness to bedrock and rock outcrops can be overcome by special design where the soil is used for community development. Capability unit VIIe-7; Very Shallow range site.

55—Steedman silt loam, 1 to 3 percent slopes. This moderately well drained, very gently sloping soil is on crests of uplands. Slopes are smooth and convex. Individual areas are 5 to 20 acres.

Typically the surface layer is very dark grayish brown silt loam to a depth of 7 inches. The upper part of the subsoil is brown silty clay to a depth of 22 inches. The lower part is mottled in shades of brown and gray to a depth of 33 inches. The underlying material is shale bedrock.

About 10 percent of this mapping unit is included areas of soils that are similar to Steedman soils except that the surface layer is slightly thicker. Inextensive areas of Coweta and Dennis soils and a few areas of stony soils are also included.

This soil has a seasonal water table 1/2 to 1 foot below the surface. Permeability is slow, and available water capacity is medium. The soil is used mostly for tame pasture and range. It is also suited to growing grain sorghum, small grains, and other crops.

Management is needed to maintain fertility and tilth and to control erosion where the soil is used for cultivated crops. Minimum tillage and the use of cover crops, including grasses and legumes, in the cropping system reduce runoff and help control erosion. The tilth and fertility can be maintained by adding crop residue and fertilizer to the soil. Erosion is a moderate hazard. The quality of grasses can be maintained or improved by following suitable grazing practices, protecting from fire, and adding fertilizer where needed.

The shrink-swell potential, low strength, and wetness can be overcome by special design where this soil is used for community development. Capability unit IIIe-2; Loamy Prairie range site.

56—Steedman silt loam, 3 to 5 percent slopes. This moderately well drained, gently sloping soil is on side slopes of uplands. Slopes are smooth and convex. Individual areas are 8 to 35 inches.

Typically the surface layer is very dark brown silt loam to a depth of 5 inches. The upper part of the subsoil is very dark grayish brown silty clay loam to a depth of 8 inches and brown silty clay to a depth of 19 inches. The lower part is olive brown silty clay to a depth of 27 inches and mottled in shades of brown and gray to a depth of 34 inches. The underlying material is shale bedrock.

About 15 percent of this mapping unit is included areas of soils that are similar to Steedman soils except that the surface layer is thicker. Inextensive areas of Dennis, Foraker, and Shidler soils and a few areas of Steedman stony soils are also included.

This soil has a seasonal water table 1/2 to 1 foot below the surface. Permeability is slow, and available water capacity is medium. The soil is used mostly for tame pasture and range. It is also suited to small grains and other crops.

Management is needed to maintain tilth and fertility and to control erosion where this soil is used for cultivated crops. Returning adequate amounts of crop residue and fertilizer to these soils maintains soil tilth and fertility. Terracing, contour farming, and using crop residue are needed to control water erosion. The quality of grasses can be maintained or improved by following suitable grazing practices, protecting the soil from fire, and adding fertilizer where needed.

The shrink-swell potential, low strength, and wetness can be overcome by special design where this soil is used for community development. Capability unit IVe-1; Loamy Prairie range site.

57—Steedman-Coweta complex, 3 to 15 percent slopes. This complex consists of small areas of Steedman and Coweta soils that are so intermingled that they could not be separated at the scale selected for mapping. These soils are on side slopes and crests of uplands. Individual areas of the mapping unit are 20 to 400 acres. Individual areas of each soil are 5 to 20 acres.

The Steedman soil makes up about 65 percent of the mapped acreage. It is a moderately deep, well drained to moderately well drained, gently sloping through moderately steep soil. It is on more stony, steeper convex parts of the landscape between bands of Coweta soil. Typically the surface layer is very dark grayish brown silt loam to a depth of 8 inches. The upper part of the subsoil is brown silty clay to a depth of 17 inches and dark grayish brown silty clay to a depth of 23 inches. The lower part is silty clay mottled in shades of gray and brown to a depth of 28 inches. The underlying material is shale bedrock.

This soil has a seasonal water table 1/2 to 1 foot below the surface. Permeability is slow, and available water capacity is medium.

The Coweta soil makes up about 20 percent of the mapped acreage. It is a shallow, well drained to somewhat excessively drained, very gently sloping through moderately steep soil. It is on less stony, less sloping parts of the landscape on contour bands between areas of Steedman soils. Typically the surface layer is very dark grayish brown loam to a depth of 6 inches. The subsoil is dark grayish brown gravelly loam to a depth of 12 inches. The underlying material is sandstone bedrock.

This soil has moderate permeability and low available water capacity.

About 10 percent of this mapping unit is included areas of soils that are similar to Steedman soils except that the surface layer is thicker, and 5 percent is Bates soils.

These soils are used mostly for range. Management is needed to maintain or improve the quality of vegetation by following suitable grazing practices and protecting the soil from fire.

The limited thickness to bedrock, shrink-swell potential, low strength, and wetness should be overcome by special design where these soils are used for community development. Capability unit VIIs-8; Steedman part in Loamy Prairie range site, Coweta part in Shallow Prairie range site.

58—Steedman-Coweta complex, 15 to 25 percent slopes. This complex consists of small areas of Steedman and Coweta soils that are so intermingled that they could not be separated at the scale selected for mapping (fig. 9). These soils are on side slopes and crests of uplands. Individual areas of the mapping unit are 15 to 150 acres. Individual areas of each soil are 4 to 15 acres.

The Steedman soil makes up about 55 percent of the mapped acreage. It is a moderately deep, well drained to moderately well drained, moderately steep or steep soil. It is on more stony, steeper convex parts of the landscape between bands of Coweta soil. Typically the surface layer is very dark brown silt loam to a depth of 6 inches. The upper part of the subsoil is dark grayish brown silty clay to a depth of 10 inches and grayish brown silty clay to a depth of 17 inches. The lower part is silty clay mottled in shades of brown and gray to a depth of 36 inches. The underlying material is shale bedrock.

This soil has a seasonal water table 1/2 to 1 foot below the surface. Permeability is slow, and available water capacity is medium.

The Coweta soil makes up about 20 percent of the mapped acreage. It is a shallow, well drained to somewhat excessively drained, moderately steep or steep soil. It is on less stony, less sloping parts of the landscape on contour bands between areas of Steedman soil. Typically the surface layer is very dark grayish brown loam to a depth of 7 inches. The subsoil is dark brown loam to a depth of 11 inches. The underlying material is sandstone bedrock.

This soil has moderate permeability and low available water capacity.

About 10 percent of this mapping unit is included areas of soils that are similar to Steedman soils except that the surface layer is thicker, 10 percent is Bates soils, and 5 percent is soils that are similar to Steedman soils except that the thickness to bedrock is less than 20 inches. Inextensive areas of Foraker and Shidler soils are also included.

These soils are used mostly for range. Management is needed to maintain or improve the quality of vegetation by following suitable grazing practices and by protecting the soil from fire.

The limited soil thickness to bedrock, slope, shrink-swell potential, low strength, and wetness can be overcome by special design where these soils are used for community development. Capability unit VIIs-8; Steedman part in Loamy Prairie range site, Coweta part in Shallow Prairie range site.

59—Stephenville-Darnell complex, 1 to 5 percent slopes. This complex consists of small areas of Stephenville and Darnell soils that are so intermingled that they could not be separated at the scale selected for mapping. These soils are on side slopes and crests of uplands. Individual areas of the mapping unit are 15 to 100 acres. Individual areas of each soil are 5 to 15 acres.

The Stephenville soil makes up about 45 percent of the mapped acreage. It is a moderately deep, well drained, very gently sloping through gently sloping soil. It is on slightly lower parts of the landscape. Typically the surface layer is very dark brown fine sandy loam to a depth of 5 inches. The subsurface layer is dark grayish brown fine sandy loam to a depth of 14 inces. The subsoil is strong brown sandy clay loam to a depth of 30 inches. The underlying material is sandstone bedrock.

This soil has moderate permeability and medium available water capacity.

The Darnell soil makes up about 30 percent of the mapped acreage. It is a shallow, well drained to somewhat excessively drained, very gently sloping through gently sloping soil. It is on slightly higher parts of the landscape. Typically the surface layer is very dark grayish brown fine sandy loam to a depth of 4 inches. The subsoil is brown fine sandy loam to a depth of 15 inches. The underlying material is sandstone bedrock.

This soil has moderately rapid permeability and low available water capacity.

About 15 percent of this mapping unit is included areas of Niotaze soils, 5 percent is Gasil soils, and 5 percent is Steedman soils. Also included are inextensive areas of Bates, Coweta, Cleora, Konawa, and Teller soils.

These soils are used mostly for range or tame pasture. They are also suited to small grains, grain sorghum, trees for firewood and posts, and other crops.

Management is needed to control erosion and to maintain fertility and tilth. The very severe hazard of erosion can be controlled by terracing, contour farming, strip-cropping, and using high residue producing crops in the cropping system. Using crop residue and fertilizer help maintain soil tilth and fertility. The quality of grasses can be maintained or improved by following suitable grazing practices, controlling brush, protecting the soil from fire, and applying needed fertilizer (fig. 10).

The limited soil thickness to bedrock can be overcome by special design where these soils are used for community development. Capability unit IVe-4; Stephenville part in Sandy Savannah range site, Darnell part in Shallow Savannah range site.

60—Stoneburg-Lucien complex, 3 to 12 percent slopes. This complex consists of small areas of Stoneburg and Lucien soils that are so intermingled that they could not be separated at the scale selected for mapping. Individual areas of the mapping unit are 5 to 25 acres. Individual areas of each soil are 1 to 10 acres.

The Stoneburg soil makes up about 50 percent of the mapped acreage. It is a moderately deep, well drained, gently sloping through strongly sloping soil. It is on

slightly lower, convex parts of the landscape. Typically the surface layer is dark brown fine sandy loam to a depth of 10 inches. The upper part of the subsoil is dark reddish brown fine sandy loam to a depth of 14 inches. The lower part is reddish brown sandy clay loam to a depth of 27 inches. The underlying material is sandstone bedrock to a depth of 30 inches.

This soil has moderate permeability and medium available water capacity.

The Lucien soil makes up about 25 percent of the mapped acreage. It is a shallow, well drained, nearly level through gently sloping soil. It is on slightly higher parts of the landscape. Typically the surface layer is dark brown fine sandy loam to a depth of 7 inches. The subsoil is dark brown fine sandy loam to a depth of 18 inches. The underlying material is sandstone bedrock.

This soil has moderately rapid permeability and low available water capacity.

About 10 percent of this mapping unit is included areas of Corbin soils, 10 percent is soils that are similar to Lucien soils except that thickness to bedrock is less than 10 inches, and 5 percent is Grainola soils. Also included are inextensive areas of Coweta and Shidler soils.

These soils are used mostly for range and tame pasture. The quality of grasses can be maintained or improved by following suitable grazing practices, protecting the soil from fire, and controlling brush.

The limitation of thickness to bedrock can be overcome by special design where these soils are used for community development. Capability unit VIe-3; Stoneburg part in Loamy Prairie range site, Lucien part in Shallow Prairie range site.

61—Summit silty clay loam, 3 to 5 percent slopes. This deep, moderately well drained, gently sloping soil is on side slopes of uplands. Slopes are smooth and convex. Individual areas are 10 to 60 acres.

Typically the surface layer is black silty clay loam to a depth of 9 inches (fig. 11). The upper part of the subsoil is black silty clay loam to a depth of 17 inches. The middle part is very dark gray silty clay to a depth of 26 inches and dark grayish brown silty clay to a depth of 57 inches. The lower part is silty clay mottled in shades of brown and gray to a depth of 72 inches.

About 10 percent of this mapping unit is included areas of Apperson soils, and 5 percent is Foraker soils. Inextensive areas of Shidler soils and soils that are similar to Summit soils except that the surface layer is thinner or that the subsoil is redder are also included.

This soil has a seasonal water table 2 to 3 feet below the surface. Permeability is slow, and available water capacity is high. The soil is used mostly for range. It is also suited to grain sorghum, small grains, tame pasture grasses, corn, soybeans, and other crops.

Management is needed to maintain tilth and fertility and to help control erosion. Terracing, contour farming, adding fertilizer, and using crop residue are needed to maintain tilth and fertility and control erosion. Tilling excessively or when the soil is wet should be avoided. The quality of grasses can be maintained or improved by following suitable grazing practices, protecting the soil from fire, and adding fertilizer where needed.

The shrink-swell potential and low strength can be overcome by special design where this soil is used for community development. Capability unit IIIe-2; Loamy Prairie range site.

62—Summit-Shidler complex, 3 to 12 percent slopes. This complex consists of small areas of Summit and Shidler soils that are so intermingled that they could not be separated at the scale selected for mapping. These soils are on crests and side slopes of uplands. Individual areas of the mapping unit are 40 to 500 acres. Individual areas of each soil are 5 to 20 acres.

The Summit soil makes up about 35 percent of the mapped acreage. It is a deep, moderately well drained, gently sloping through strongly sloping soil. It is on less stony, convex parts of the landscape. Typically the surface layer is black silty clay loam to a depth of 11 inches. The upper part of the subsoil is very dark gray silty clay loam to a depth of 18 inches. The next part is very dark grayish brown silty clay to a depth of 27 inches and dark grayish brown silty clay to a depth of 39 inches. The lower part is silty clay mottled in shades of brown and gray to a depth of 69 inches.

This soil has a seasonal water table 2 to 3 feet below the surface. Permeability is slow, and available water capacity is high.

The Shidler soil makes up about 25 percent of the mapped acreage. It is a shallow, well drained, gently sloping soil. It is on slightly higher, more stony, convex contour bands between areas of Summit soils. Typically the surface layer is very dark brown silty clay loam to a depth of 8 inches. Below this is hard limestone bedrock.

This soil has moderate permeability and low available water capacity.

About 20 percent of this mapping unit is included areas of Apperson soils, 10 percent is Foraker soils, 5 percent is Corbin soils, 2 percent is Grainola soils, and 2 percent is Verdigris soils.

These soils are used mostly for range and hay meadows. They are also suited to tame pasture grasses. The quality of grasses can be maintained or improved by following suitable grazing practices, protecting the soil from fire, and adding fertilizer where needed.

The shrink-swell potential, low strength, and limitation of thickness to bedrock can be overcome by special design where these soils are used for community development. Capability unit VIs-2; Summit part in Loamy Prairie range site, Shidler part in Very Shallow range site.

63—Teller loam, 3 to 5 percent slopes. This deep, well drained, gently sloping soil is on side slopes of uplands. Slopes are smooth and convex. Individual areas are 25 to 75 acres.

Typically the surface layer is dark brown loam to a depth of 8 inches. The upper part of the subsoil is dark brown loam to a depth of 14 inches. The middle part is dark reddish brown clay loam to a depth of 32 inches and

reddish brown clay loam to a depth of 52 inches. The lower part is reddish brown loam to a depth of 60 inches.

About 10 percent of this mapping unit is included areas of Norge soils, 5 percent is Minco soils, and 2 percent is Konawa soils. Also included are inextensive areas of soils that are similar to Teller soils except that the surface layer is thinner.

This soil has moderate permeability and high available water capacity. It is used mostly for wheat. It is also suited to other small grains, grain sorghum, corn, soybeans, peanuts, tame pasture grasses, range grasses, and other crops.

Management is needed to maintain fertility and tilth and to control erosion. The erosion hazard can be reduced by terracing, contour farming, stripcropping, and using crop residue. Crop residue should be used for soil improvement, and fertilizer should be added to the soils.

This soil is suited to community development and recreation. Capability unit IIIe-3; Loamy Prairie range site.

64—Vanoss silt loam, 0 to 1 percent slopes. This deep, well drained, nearly level soil is on crests of uplands. Slopes are smooth and convex. Individual areas are 50 to 150 acres.

Typically the surface layer and the next layer are very dark grayish brown silt loam to a depth of 12 inches. The upper part of the subsoil is dark brown silty clay loam to a depth of 19 inches and brown silty clay loam to a depth of 56 inches. The lower part is brown clay loam to a depth of 72 inches.

About 10 percent of this mapping unit is included areas of soils that are similar to Vanoss soils except that the dark colors of the upper layers are 20 to 30 inches thick, 5 percent is soils that are similar to Vanoss soils except that the subsoil is more clayey, and a small area is Teller soils. Also included are inextensive areas of Minco soils.

This soil has moderate permeability and high available water capacity. It is used mostly for wheat and tame pasture grasses. It is also suited to alfalfa, grain sorghum, peanuts, other small grains, soybeans, range grasses, corn, and other crops.

Management is needed to maintain fertility and tilth. This can be done by using legumes and grasses in the cropping system, using crop residue, adding fertilizer, and avoiding excessive tillage.

The shrink-swell potential and low strength can be overcome by special design where this soil is used for community development. Capability unit I-2; Loamy Prairie range site.

65—Vanoss silt loam, 1 to 3 percent slopes. This deep, well drained, very gently sloping soil is on side slopes of uplands. Slopes are smooth and convex. Individual areas are 40 to 90 acres.

Typically the surface layer and the next layer are very dark grayish brown silt loam to a depth of 11 inches. The subsoil is dark yellowish brown silty clay loam to a depth of 16 inches and brown silty clay loam to a depth of 58 inches. The underlying material is brown loam to a depth of 72 inches.

About 10 percent of this mapping unit is included areas of soils that are similar to Vanoss soils except that the dark colored red materials of the upper layers are 20 to 30 inches thick, 5 percent is Norge soils, and 5 percent is Minco soils. Also included are inextensive areas of Teller soils.

This soil has moderate permeability and high available water capacity. It is used mostly for wheat and tame pasture grasses. It is also suited to alfalfa, grain sorghum, peanuts, other small grains, soybeans, corn, range grasses, and other crops.

Management is needed to maintain fertility and tilth and to protect the soil from erosion. Crop residue and fertilizer should be returned to the soil and excessive tillage should be avoided. Terracing and contour farming are needed where row crops are grown.

The shrink-swell potential and low strength can be overcome by special design where this soil is used for community development. Capability unit IIe-2; Loamy Prairie range site.

66—Verdigris silt loam. This deep, moderately well drained, nearly level through very gently sloping soil is on flood plains. Slopes are slightly uneven and mostly convex. Individual areas are 10 to 80 acres.

Typically the surface layer and the next layer are very dark grayish brown silt loam to a depth of 21 inches. The subsoil is very dark grayish brown silty clay loam to a depth of 72 inches.

About 30 percent of this mapping unit is included areas of soils that are similar to Verdigris soils except that they are slightly more sandy, 10 percent is soils that are similar to Verdigris soils except that the subsoil is redder, and 5 percent is soils that are similar to Verdigris soil except that the subsoil contains gravel. Inextensive areas of stream channels and of Barnsdall, Cleora, Mason, and Wynona soils are also included.

This soil has a seasonal water table 2 to 3 feet below the surface. Permeability is moderate, and available water capacity is high. The soil is occasionally flooded. It is used mostly for tame pasture. It is also suited to alfalfa, grain sorghum, small grains, corn, soybeans, range grasses, trees, and other crops.

Management is needed to maintain tilth and fertility and to protect the soil from flooding. Diversion terraces are needed in some areas to divert water from adjacent soils on uplands. Crop residue and fertilizer should be added to the soil and excessive tillage should be avoided.

Flooding can be overcome by special design where this soil is used for recreation. Capability unit IIw-1; Loamy Bottomland range site.

67—Verdigris soils. This mapping unit consists of deep, moderately well drained, nearly level through very gently sloping soils on flood plains. Slopes are slightly uneven and mostly convex. Individual areas are 20 to 60 acres.

Typically the surface layer is black silt loam to a depth of 12 inches. The next layer is very dark brown silt loam to a depth of 18 inches. The subsoil is very dark grayish brown silty clay loam to a depth of 38 inches. The under-

lying material is dark grayish brown silty clay loam to a depth of 60 inches.

About 15 percent of this mapping unit is included areas of Cleora soils, 5 percent is Mason soils, and 5 percent is Barnsdall soils. Also included are inextensive areas of Wynona soils and stream channels.

This soil has a seasonal water table 2 to 3 feet below the surface. Permeability is moderate, and available water capacity is high. The soil is frequently flooded. It is used mostly for tame pasture, range, or woodland.

The main concerns of management are controlling flooding and maintaining fertility. The quality of grasses can be maintained or improved by following suitable grazing practices, protecting the soil from fire, controlling brush, and adding fertilizer where needed.

Flooding can be overcome by special design where this soil is used for recreation. Capability unit Vw-1; Loamy Bottomland range site.

68—Wolco silty clay loam, 1 to 3 percent slopes. This deep, moderately well drained, very gently sloping soil is on crests of uplands. Slopes are smooth and convex. Individual areas are 5 to 50 acres.

Typically the surface layer is black silty clay loam to a depth of 14 inches. The upper part of the subsoil is very dark brown silty clay loam to a depth of 21 inches. The lower part is silty clay mottled in shades of brown and red to a depth of 55 inches. Below this is hard limestone bedrock.

About 10 percent of this mapping unit is included areas of Lula soils, 10 percent is soils that are similar to Wolco soils except that thickness to bedrock is more than 60 inches, and 5 percent is Apperson soils. Also included are inextensive areas of Dwight, Parsons, and Summit soils.

This soil has slow permeability and high available water capacity. It is used mostly for range. It is also suited to alfalfa, grain sorghums, small grains, tame pasture grasses, soybeans, corn, and other crops.

Management is needed to maintain fertility and tilth and protect the soil from erosion. Minimum tillage and the use of cover crops, including grasses and legumes, in the cropping system, reduce runoff and help control erosion. The tilth and fertility can be maintained by adding crop residue and fertilizer to the soil. The quality of grasses can be maintained or improved by following suitable grazing practices, protecting the soil from fire, and adding fertilizer where needed.

The shrink-swell potential and low strength can be overcome by design where this soil is used for community development. Capability unit IIe-1; Loamy Prairie range site.

69—Wolco-Dwight complex, 0 to 3 percent slopes. This complex consists of small areas of Wolco and Dwight soils that are so intermingled that they could not be separated at the scale selected for mapping. These soils are on crests of uplands. Individual areas of the mapping unit are 30 to 250 acres. Individual areas of each soil are 1 to 15 acres.

The Wolco soil makes up about 50 percent of the mapped acreage. It is a deep, moderately well drained, nearly level through very gently sloping soil. It is on slightly higher, convex parts of the landscape. Typically the surface layer is very dark brown silty clay loam to a depth of 12 inches. The upper part of the subsoil is dark brown silty clay loam to a depth of 17 inches. The middle part is reddish brown silty clay to a depth of 47 inches. The lower part is yellowish red silty clay to a depth of 58 inches. Below this is hard limestone bedrock.

This soil has slow permeability and high available water capacity.

The Dwight soil makes up about 25 percent of the mapped acreage. It is a deep, moderately well drained, nearly level through very gently sloping soil. It is on slightly lower, concave parts of the landscape. Typically the surface layer is very dark grayish brown silt loam to a depth of 5 inches. The subsoil is dark brown silty clay to a depth of 16 inches and reddish brown silty clay to a depth of 54 inches. Below this is hard limestone bedrock.

This soil has excessive amounts of exchangeable sodium in the upper part of the subsoil. Available water capacity is low, and permeability is very slow.

About 15 percent of this mapping unit is included areas of soils that are similar to Dwight soils exept that the surface layer is thicker, 5 percent is Lula soils, 3 percent is Apperson soils, and 2 percent is Corbin soils. Inextensive areas of Shidler soils are also included.

These soils are used mostly for range. They are also suited to alfalfa, grain sorghum, small grains, soybeans, tame pasture grasses, and other crops.

Management is needed to improve and maintain tilth and fertility and to help control erosion. Returning adequate amounts of crop residue and fertilizer to these soils improves soil structure, reduces surface crusting, helps control erosion, and helps maintain soil fertility. Tilling these soils on the contour and at variable depths helps to control runoff and erosion, and increases water intake. Tillage should be timely and kept at a minimum. Tilling or grazing these soils when wet causes excessive compaction. The quality of grasses can be maintained or improved by following suitable grazing practices, protecting the soil from fire, and adding fertilizer where needed.

The shrink-swell potential, low strength, and high exchangeable sodium content can be overcome by special design where these soils are used for community development. Capability unit IVs-1; Wolco part in Loamy Prairie range site, Dwight part in Shallow Claypan range site.

70—Wynona silty clay loam. This deep, somewhat poorly drained, nearly level soil is on flood plains. Slopes are smooth and concave. Individual areas are 15 to 70 acres.

Typically the surface layer is very dark gray silty clay loam to a depth of 8 inches. The upper part of the subsoil is black silty clay loam to a depth of 23 inches and very dark gray silty clay loam to a depth of 47 inches. The lower part is dark gray silty clay to a depth of 63 inches.

About 15 percent of this mapping unit is included areas of Osage soils, 5 percent is Mason soils, and 5 percent is Verdigris soils. Also included are inextensive areas of soils that are similar to Wynona soils except that they are slightly more sandy.

This soil has a seasonal water table at the surface to 2 feet below the surface. Permeability is slow, and available water capacity is high. The soil is occasionally flooded. It is used mostly for tame pasture and woodland. It is also suited to alfalfa, grain sorghum, small grains, soybeans, corn, range grasses, and other crops.

Management is needed to control wetness, prevent flooding, and maintain tilth and fertility. Surface drains are generally sufficient to control wetness. Diversion terraces are needed in some areas to divert water from adjacent soils on uplands. Crop residue and fertilizer should be added to the soil to maintain tilth and fertility. The quality of grasses can be maintained or improved by following suitable grazing practices, protecting the soil from fire, and applying fertilizer where needed.

The flooding and wetness can be overcome by special design where this soil is used for recreation. Capability unit IIw-1; Loamy Bottomland range site.

Use and Management of the Soils

JOHN R. BOGARD, district conservationist, helped prepare this section.

The soil survey is a detailed inventory and evaluation of the most basic resource of the survey area—the soil. It is useful in adjusting land use, including urbanization, to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in uses of the land.

While a soil survey is in progress, soil scientists, conservationists, engineers, and others keep extensive notes about the nature of the soils and about unique aspects of behavior of the soils. These notes include data on erosion, drought damage to specific crops, yield estimates, flooding, the functioning of septic systems, and other factors affecting the productivity, potential, and limitations of the soils under various uses and management. In this way, field experience and measured data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section is useful in planning use and management of soils for crops and pasture, rangeland, and woodland, and as sites for buildings, highways and other transportation systems, sanitary facilities, parks and other recreation facilities, and wildlife habitat. From the data presented, the potential of each soil for specified land uses can be determined, soil limitations to these land uses can be identified, and costly failures in houses and other structures, caused by unfavorable soil properties, can be avoided. A site where soil properties are favorable can be selected, or practices that will overcome the soil limitations can be planned.

Planners and others using the soil survey can evaluate the impact of specific land uses on the overall productivity of the survey area or other broad planning area and on the environment. Productivity and the environment are closely related to the nature of the soil. Plans should maintain or create a land-use pattern in harmony with the natural soil.

Contractors can find information that is useful in locating sources of sand and gravel, roadfill, and topsoil. Other information indicates the presence of bedrock, wetness, or very firm soil horizons that cause difficulty in excavation.

Health officials, highway officials, engineers, and many other specialists also can find useful information in this soil survey. The safe disposal of wastes, for example, is closely related to properties of the soil. Pavements, sidewalks, campsites, playgrounds, lawns, and trees and shrubs are influenced by the nature of the soil.

Crops and Pasture

THEODORE B. LEHMAN, conservation agronomist, Soil Conservation Service, helped prepare this section.

The major management concerns in the use of the soils for crops and pasture are described in this section. In addition, the crops or pasture plants best suited to the soil, including some not commonly grown in the survey area, are discussed; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are presented for each soil.

This section provides information about the overall agricultural potential of the survey area and about the needed management practices. The information is useful to equipment dealers, land improvement contractors, fertilizer companies, processing companies, planners, conservationists, an others. For each kind of soil, information about management is presented in the section "Soil Map for Detailed Planning." Planners of management systems for individual fields or farms should also consider the detailed information given in the description of each soil.

The soils in Osage County can potentially produce more food. In addition to the reserve productive capacity represented by land not presently cultivated, food production could also be increased considerably by extending the latest crop production technology to all cropland in the county. This soil survey can greatly facilitate the application of such technology.

Acreage in crops has gradually been decreasing as more and more land is used for urban development. The use of this soil survey to help make land-use decisions that will influence the future role of farming in the county is discussed in the section "Soil Map for Detailed Planning."

Soil erosion is the major concern on cropland in Osage County. If the slope is more than 2 percent, erosion is a hazard. Apperson, Bates, Corbin, Dennis, and Dougherty soils, for example, have slopes of 2 percent or more.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. This is especially damaging on soils with a clayey subsoil, such as Apperson, Lightning, Parsons, and Carytown soils. Erosion also reduces productivity on soils that tend to be droughty, such as Shidler and Darnell soils. Second, soil erosion on farmland results in sedimentation. Control of erosion minimizes sedimentation and improves the quality of water for municipal use, for recreation, and for fish and wildlife.

Erosion control practices provide protective surface cover, reduce runoff, and increase infiltration. A cropping system that keeps vegetative cover on the soil for extended periods can hold soil erosion losses to amounts that will not reduce the productive capacity of the soils. On livestock farms, which require pasture and hay, the legume and grass forage crops in the cropping system reduce erosion on sloping land, provide nitrogen, and improve tilth for the following crop.

Minimizing tillage and leaving crop residue on the surface help to increase infiltration and to reduce the hazards of runoff and erosion. These practices can be adapted to most soils in the survey area, but they are more difficult to use successfully on eroded soils and on soils that have a clayey surface layer, such as Osage soils.

Terraces and diversions reduce the length of slope and reduce runoff and erosion. They are most practical on deep, well drained soils that have regular slopes, such as Apperson and Dennis soils. Some soils are less suitable because of irregular slopes, excessive wetness, a clayey subsoil which would be exposed in terrace channels, or bedrock at a depth of less than 40 inches.

Contouring and contour stripcropping are suitable erosion control practices in the survey area. They are best adapted to soils with smooth, uniform slopes, including most areas of the sloping Apperson, Bates, Corbin, Dennis, Gasil, Konawa, Lula, Norge, and Summit soils.

Soil blowing is a hazard on the sandy Dougherty and Eufaula soils. Blowing can damage these soils in a few hours if winds are strong and the soils are dry and bare of vegetation or surface mulch. Maintaining vegetative cover, surface mulch or rough surfaces minimizes blowing on these soils.

Information for the design of erosion control practices for each kind of soil is contained in the Technical Guide, available in local offices of the Soil Conservation Service.

Drainage is needed on some of the soils used for crops and pasture in the survey area. Osage and Wynona soils, for example, need drainage.

Fertility is not naturally low in most soils in the survey area. All of the soils, however, require added fertilizer for economical production of crops and pasture grasses. Many soils on uplands are acid and need application of ground limestone to raise the pH sufficiently for good growth of alfalfa and other crops that grow best on nearly neutral soils. On all soils, addition of lime and fertilizer should be based on the results of soil tests, on the need of the crop, and on the expected level of yields.

Soil tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils with good tilth are granular and porous.

Most of the soils used for crops in the survey area have a loamy surface layer. Generally the structure of such soils is weak, and intense rainfall causes the formation of a crust on the surface. The crust when dry is hard and nearly impervious to water. Once the crust forms, it reduces infiltration and increases runoff. Regular additions of crop residue, manure, and other organic material can help to improve soil tilth and to reduce crust formation.

Leaving crop residue on the surface during winter and spring or working it partly into the surface is needed to protect soils from erosion. Organic matter, or humus, supplied in crop residue improves the tilth of the surface layer. The improved tilth then increases infiltration and the storage of water, reduces the hazard of erosion, and helps prevent crusting.

The main objectives in using soil-improving crops are maintaining or improving the physical condition and the productivity of the soil, and controlling erosion, weeds, insects, and diseases. A cropping system that improves the soil includes crops that produce large amounts of residue. The residue and the addition of fertilizer help maintain soil tilth and fertility.

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 5. 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. Absence of an estimated yield indicates that the crop is not suited to or not commonly grown on the soil or that a given crop is not commonly irrigated.

The estimated yields were based mainly on the experience and records of farmers, conservationists, and extension agents. Results of field trials and demonstrations and available yield data from nearby counties were also considered.

The yields were estimated assuming that the latest soil and crop management practices were used. Hay and pasture yields were estimated for the most productive varieties of grasses and legumes climatically suited to the area and the soil. A few farmers may be obtaining average yields higher than those shown in table 5.

The management needed to achieve the indicated yields of the various crops depends on the kind of soil and the crop. Such management provides drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate tillage practices, including time of tillage and seedbed preparation and tilling when soil moisture is favorable; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for

each crop; effective use of crop residues, barnyard manure, and green-manure crops; harvesting crops with the smallest possible loss; and timeliness of all fieldwork.

The estimated yields reflect the productive capacity of the soils 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 5 are grown in the survey area, but estimated yields are not included because the acreage of these crops is small. The local offices of the Soil Conservation Service and the Cooperative Extension Service can provide information about the management concerns and productivity of the soils for these crops.

Management of Tame Pasture

Much of the acreage in Osage County is used for pasture grasses, native grasses, and crops that livestock graze. The main crops and grasses used for these purposes are winter small grains, sudangrass, native grasses, improved bermudagrass, and tall fescue. Lovegrass, switchgrass, Caucasian bluestem, and King Ranch bluestem are also adapted to some of the soils.

Production of winter small grains, when used for livestock grazing, compare favorably with production of tall fescue. Sudangrass and switchgrass can be used as a supplement during summer. Improved bermudagrass can be grown on all of the soils in the area. However, the shallow limestone soils are droughty. Tall fescue provides grazing from late in fall through spring. It is best suited to the soils on flood plains and to the more clayey soils on uplands.

The percentage of forage yields, for grazing, is listed by grass or crop by months in figure 12.

A pasture program needs to be planned so forage will be available during each month of the year. A study of the growth habits of the different plants is necessary to assure adequate forage each month. The months in which various kinds of forage plants grow are indicated in figure 12. The percentage of growth for each kind of plant is illustrated in a graph. For example, bermudagrass makes 20 percent of its yearly growth for grazing during June.

Soils vary in their capacity to produce forage for grazing. The Mason soil produces more forage than the Bates soils primarily because it furnishes more available moisture to the plant. The total yearly production of various kinds of pasture plants on each soil is given in animal unit months (AUM) in table 6. For example, bermudagrass on Bates loam, 1 to 3 percent slopes, will furnish grazing for one animal unit for 6 months during the year.

In planning a pasture program, one must consider the total yearly production of the pasture plant (as given in table 6) and the growth the plant will make for a certain month (as shown in figure 12). As illustrated in figure 12, bermudagrass furnished 20 percent of its annual forage during June; it therefore provides grazing for 1.2 animals on the Bates soil in June since its yearly production is 6 AUM 20 percent × 6 AUM = 1.2 AUM. A 50-acre pasture would furnish grazing for 60 animals (50 acres x 1.2 AUM = 60 AUM) during June. Personnel in the Soil Conservation Service or in the County Extension Office can help plan a total pasture program for your farm.

Capability Classes and Subclasses

Capability classes and subclasses show, in a general way, the suitability of soils for most kinds of field crops. The soils are classed according to their limitations when they are used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for forest trees, or for engineering purposes.

In the capability system, all kinds of soil are grouped at three levels: capability class, subclass, and unit. These levels are defined in the following paragraphs. A survey area may not have soils of all classes.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use; they are defined as follows:

Class I soils have few limitations that restrict their use.

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

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

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

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

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

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

Class VIII soils and landforms have limitations that nearly preclude their use for commercial crop production.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth

or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

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

The capability unit is identified in the description of each soil mapping unit in the section "Soil Map for Detailed Planning." Capability units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-2 or IIIe-1.

Range

ERNEST C. SNOOK, range conservationist, Soil Conservation Service, helped prepare this section.

This section contains information about use of the soils for range. Range is land on which the natural plant community is composed principally of grasses, grasslike plants, forbs, and shrubs valuable for grazing and in sufficient quantity to justify grazing use.

About 70 percent of Osage County is in native range on which domestic animals graze. Ninety percent of farm or ranch income is derived from livestock, principally cattle. The average ranch in the county is about 1,035 acres. The native range is usally grazed all year long, but the forage is supplemented by protein and hay or tame pasture during the season when grasses are dormant. On some ranches calves and yearlings are creep-fed to increase market weight. Productivity of the range can be increased by using management practices that are effective for specific kinds of soil and range sites.

Where climate and topography are about the same, differences in the kind and amount of vegetation that rangeland can produce are related closely to the kind of soil. Effective management is based on the relationships among soils, vegetation, and water.

Table 7 shows, for each kind of soil, the name of the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the expected percentage of each species in the composition of the potential natural plant community. Soils not listed cannot support a natural plant community of predominately grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. The following are explanations of column headings in Table 7.

A *range site* is a distinctive kind of rangeland that differs from other kinds of rangeland in its ability to produce a characteristic natural plant community. Soils that produce a similar kind, amount, and proportion of range plants are grouped into range sites. For those areas where the relationship between soils and vegetation has been established, range sites can be interpreted directly from the soil map. Properties that determine the capacity of the soil to supply moisture and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production refers to the amount of vegetation that can be expected to grow annually on well-managed rangeland that is supporting the potential natural plant community. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year the amount and distribution of precipitation and the temperatures are such that growing conditions are substantially better than average; in a normal year these conditions are about average for the area; in an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight refers to the total air-dry vegetation produced per acre each year by the potential natural plant community. Vegetation that is highly palatable to livestock and vegetation that is unpalatable are included. Some of the vegetation can also be grazed extensively by wildlife.

Common plant names of grasses, grasslike plants, forbs, and shrubs that make up most of the potential natural plant community on each soil are listed by common name. Under *Composition*, the expected proportion of each species is presented as the percentage, in air-dry weight, of the total annual production of herbaceous and woody plants. Because only major species are listed, percentages do not necessarily total 100. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season. Generally all of the vegetation produced is not used.

Range management requires, in addition to knowledge of the kinds of soil and the potential natural plant community, an evaluaton of the present condition of the range vegetation in relation to its potential. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the maximum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat and protects soil and water resources.

The major management concern on most rangeland is control of grazing so that the kinds and amounts of plants that make up the potential natural plant community are reestablished. Forage production is approximately half of that originally produced because the natural vegetation in many parts of the survey area has been greatly depleted by continued excessive use. Much of the acreage that was once open grassland is now covered with brush, weeds, and cactus. Soil blowing occurs on sandy soils that are not adequately covered.

Manipulating or reducing undesirable brush species and minimizing soil blowing are important management concerns. Sound range management based on soil survey information and other rangeland inventory information is the basis for maintaining or improving forage production.

Trees

This section gives information on the suitablility of soils for trees in Osage County. Stands of post oak, blackjack oak, and hickory grow on the Darnell, Eufaula, Dougherty, Stephenville, and Niotaze soils, mostly in the eastern half of the county. Other tree and shrub cover is mostly limited to the flood plains along the major rivers and creeks and their tributaries. Among the major species in such areas are American elm, green ash, and hackberry. Pecan is a major species on Bird and Hominy Creeks and the Caney River; Eastern cottonwood is a major species along the Arkansas River. Secondary species are American sycamore, honeylocust, and pin oak. Minor species are chinquapin oak, black walnut, bur oak, northern red oak, osageorange, black locust, red mulberry, persimmon, willow, buttonbush, plum, chittamwood, roughleaved dogweed, redbud, river birch, flowering dogwood, red maple, Kentucky coffeetree, and western soapberry.

Natural stands of woodland in the county have watershed-protecting, wildlife, and esthetic values but only limited economic value. One sawmill operates at Fairfax.

Farmstead windbreaks, when properly designed and located, can control drifting of snow and keep it out of farmyards. They also shelter the home and farmyard. Belts of trees and shrubs are useful in screening unsightly areas. Properly planned trees and shrub screens reduce noise, add esthetic value to most areas, and control soil blowing.

On most soils, preparation for tree planting can be the same as for ordinary field crops. Many of the species adapted for tree planting are native to the county, and they grow naturally on the soils where trees are needed; however, they need special care. Soils without a severe erosion hazard can be prepared in advance of planting so that they will have time to settle. Alfalfa and grass sod should be summer fallowed at least one year before planting, and cropland can be fall plowed. Adequate cover or crop residue should be maintained on soils with a severe erosion hazard. Cover crops protect the soil both before and after planting and also protect the young tree seedlings.

Careful planning is needed for every tree planting if it is to thrive. When choosing stock for planting, select species that grow best on the type of soil found at the planting location. The recommended trees and shrubs for each soil are given in table 8. Purchase healthy seedlings from nurseries or other agencies. Plant in late winter or early spring, protect the seedlings from drying out during planting, and pack the ground so it will be firm around the roots.

Young trees need considerable care if they are to survive and thrive on most soils. Weeds need to be controlled during the first years after planting so that they do not compete for moisture. This can be done mechanically or chemically. Trees need to be protected from livestock and fire. Additional information on appropriate design for the desired purpose and on planting and care of tree plantings is available from the offices of the Soil Conservation Service, the State Forester, and the Extension Forester serving the county.

The kind of soil and the soil-air-moisture relationship greatly influence the growth of trees in this area. Trees normally grow best on deep, loamy soils. Only fair to poor growth is made on clayey soils because these soils absorb and release moisture too slowly. Deep soils are better suited than shallow soils because more moisture can be stored for use during droughty periods. Hardwoods require deeper soils than conifers, although conifers make their best growth on the better farming soils.

Conifers such as pine and eastern redcedar at first grow more slowly than hardwoods, but their growth is likely to equal that of most hardwoods as they mature. Conifers live longer than hardwoods, and they are more effective in a windbreak or a screen.

Available soil moisture, soil fertility, tree spacing, tree adaptability to the soil, and care given to the tree all affect rate of tree growth.

Wildlife Habitat

JEROME F. SYKORA, biologist, Soil Conservation Service, helped prepare this section.

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the construction of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, inadequate, or inaccessible, wildlife either are scarce or do not inhabit the area.

If the soils have the potential, wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by helping the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in planning for parks, wildlife refuges, nature study areas, and other developments for wildlife; selecting areas that

are suitable for wildlife; selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat; and 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* means that the element of wildlife habitat or the kind of habitat is easily created, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of wildlife are very severe, and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

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

Grain and seed crops are seed-producing annuals used by wildlife. Examples are corn, wheat, oats, and barley. The major soil properties 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.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Examples are fescue, lovegrass, clover, and alfalfa. Major soil properties 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.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. Examples are bluestem, goldenrod, beggarweed, wheatgrass, and grama. Major soil properties 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.

Hardwood trees and the associated woody understory provide cover for wildlife and produce nuts or other fruit, buds, catkins, twigs, bark, or foliage that wildlife eat. Examples of native plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, persimmon, sassafras, hickory, pecan, black walnut, blackberry, blackhaw, viburnum, red mulberry and osageorange. Examples of fruit-producing shrubs that are commercially available and suitable for planting on soils rated good are Russian-olive, autumn-olive, and crabapple. Major soil properties that affect growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness.

Coniferous plants are cone-bearing trees, shrubs, or ground cover plants that furnish habitat or supply food in the form of browse, seeds, or fruitlike cones. Examples are pine, spruce, fir, cedar, and juniper. Soil properties that have a major effect on the growth of coniferous plants are depth of the root zone, available water capacity, and wetness.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, or foliage used by wildlife or that provide cover and shade for some species of wildlife. Examples are coralberry, sumac, briers, skunkbush, roughleaf dogwood, huckleberry and sandplum. Major properties that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and moisture.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Examples of wetland plants are smartweed, wild millet, saltgrass, and rushes, sedges, and reeds. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness.

Shallow water areas are bodies of water that have an average depth of less than 5 feet and that are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water-control devices in marshes or streams. Examples are marshes, waterfowl feeding areas, and ponds. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed.

The kinds of wildlife habitat are briefly described in the following paragraphs.

Openland habitat 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 kinds of wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail rabbit, and red fox.

Woodland habitat consists of areas of hardwoods or conifers, or a mixture of both, and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, woodcock, thrushes, woodpeckers, squirrels, grey fox, raccoon, deer, and cottontail rabbit.

Wetland habitat consists of open, marshy or swampy, shallow-water areas where water-tolerant plants grow. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Rangeland habitat consists of areas of wild herbaceous plants and shrubs. Wildlife attracted to rangeland include white-tailed deer, bobwhite quail, prairie chicken, coyote and meadowlark.

Recreation

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for recreation uses. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreation use by the duration and intensity of flooding and the season when flooding occurs. Onsite assessment of height, duration, intensity, and frequency of flooding is essential in planning recreation facilities.

The degree of the limitation of the soils is expressed as slight, moderate, or severe. *Slight* means that the soil properties are generally favorable and that the limitations are minor and easily overcome. *Moderate* means that the 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 10 can be supplemented by information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 12, and interpretations for dwellings without basements and for local roads and streets, given in table 11.

Camp areas require such site preparation as shaping and leveling for 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 for this use 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 camping sites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for use as 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 will 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 or boulders, is firm after rains, and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of the soil over bedrock or hardpan should be enough to allow necessary grading.

Paths and trails for walking, horseback riding, bicycling, and other uses should require little or no cutting and filling. The best soils for this use are those that are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once during the annual period of use. They should have moderate slopes and have few or no stones or boulders on the surface.

Engineering

WILLIAM E. HARESTY and GEORGE K. SITES, engineers, Soil Conservation Service, helped prepare this section.

This section provides information about the use of soils for building sites, sanitary facilities, construction material, and water management. Among those who can benefit from this section are engineers, landowners, community planners, town and city managers, land developers, builders, contractors, and farmers and ranchers.

The ratings in the engineering tables are based on test data and estimated data in the "Soil Properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

Among the soil properties and site conditions identified by a soil survey and used in determining the ratings in this section were grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock that is within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density, and geologic origin of the soil material. Where pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

On the basis of information assembled about soil properties, ranges of values can be estimated for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values can be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems, and other engineering works. The ranges of values can be used to: (1) select potential residential, commercial, industrial, and recreational uses; (2) make preliminary estimates pertinent to construction in a particular area; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; (5) plan detailed onsite investigations of soils and geology; (6) find sources of gravel, sand, clay, and

topsoil; (7) plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; (8) relate performance of structures already built to the properties of the kinds of soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted; and (9) predict the trafficability of soils for cross-country movement of vehicles and construction equipment.

Data presented in this section are useful for land-use planning and for choosing alternative practices or general designs that will overcome unfavorable soil properties and minimize soil-related failures. Limitations to the use of these data, however, should be well understood. First, the data are generally not presented for soil material below a depth of 5 or 6 feet. Also, because of the scale of the detailed map in this soil survey, small areas of soils that differ from the dominant soil may be included in mapping. Thus, these data do not eliminate the need for onsite investigations, testing, and analysis by personnel having expertise in the specific use contemplated.

The information is presented mainly in tables. Table 11 shows, for each kind of soil, the degree and kind of limitations for building site development; table 12, for sanitary facilities; and table 14, for water management. Table 13 shows the suitability of each kind of soil as a source of construction materials.

The information in the tables, along with the soil map, the soil descriptions, and other data provided in this survey can be used to make additional interpretations and to construct interpretive maps for specific uses of land.

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

Building Site Development

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets are indicated in table 11. A *slight* limitation indicates that soil properties are favorable for the specified use; any limitation is minor and easily overcome. A *moderate* limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A *severe* limitation indicates one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils rated severe, such costly measures may not be feasible.

Shallow excavations are used for pipelines, sewerlines, telephone and power transmission lines, basements, open ditches, and cemeteries. Such digging or trenching is influenced by the soil wetness of a high seasonal water table, the texture and consistence of soils; the tendency of soils to cave in or slough; and the presence of very firm, dense soil layers, bedrock, or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 6 feet unless otherwise noted.

In the soil series descriptions, the consistence of each soil horizon is defined, and the presence of very firm or extremely firm horizons, usually difficult to excavate, is indicated.

Dwellings and *small commercial buildings* referred to in table 11 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence from settling or shear failure of the foundation does not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, potential frost action, soil wetness, and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns, and gardens. Depth to bedrock, slope, and large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious limitation.

Local roads and streets referred to in table 11 have an all-weather surface that can carry light to medium traffic all year. They consist of subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The classifications of the soil and the soil texture, density, shrink-swell potential, and potential frost action are indicators of the traffic supporting capacity used in making the ratings. Soil wetness, flooding, slope, depth to hard rock or very compact layers, and content of large stones affect stability and ease of excavation.

The best soils for *lawns and landscaping* are those that remain firm after rain and are not dusty when dry. They absorb water readily and hold sufficient moisture for plant growth. The surface layer should be free of stones, and if shaping is required, the soil should be sufficiently deep to bedrock or hardpan to allow for the necessary grading.

Sanitary Facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that affect ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 12 shows the degree and kind of limitations of each soil for such uses and for use of the soil as daily cover for landfills. It is important to observe local ordinances and regulations.

If the degree of soil limitation is expressed as *slight*, soils are generally favorable for the specified use and limitations are minor and easily overcome; if *moderate*, soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if *severe*, soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance is required.

Soil suitability is rated by the terms *good*, *fair*, and *poor*, which have, respectively, meaning approximately parallel to the terms *slight*, *moderate*, and *severe*.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 18 and 72 inches are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect absorption of the effluent are permeability, depth to seasonal high water table, depth to bedrock, and susceptibility to flooding. Stones, boulders, and shallowness to bedrock interfere with installation. Excessive slope may cause lateral seepage and surfacing of the effluent. Also, soil erosion and soil slippage are hazards if absorption fields are installed on sloping soils.

In some soils, loose sand and gravel or fractured bedrock is less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and ground water in the area may be contaminated.

On many of the soils that have moderate or severe limitations for use as septic tank absorption fields, a system to lower the seasonal water table could be installed or the size of the absorption field could be increased so that performance is satisfactory.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons have a nearly level floor and cut slopes or embankments of compacted soil material. Aerobic lagoons generally are designed to hold 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. Soils that are very high in organic matter and those that have cobbles, stones, or boulders are not suitable. Unless the soil has very slow permeability, contamination of ground water is a hazard where the seasonal high water table is above the level of the lagoon floor. In soils where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce the lagoon's capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the suitability of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soils affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste by placing refuse in successive layers either in excavated trenches or on the surface of the soil. The waste is spread, compacted, and covered daily with thin layers of soil. Landfill areas are subject to heavy vehicular traffic. Risk of polluting ground water and trafficability affect the suitability of a soil for this use. The best soils have a loamy or silty texture, have moderate to slow permeability, are deep to a seasonal water table, and are not subject to flooding. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability, which might allow noxious liquids to contaminate ground water. Soil wetness may be a limitation because operating heavy equipment on a wet soil is difficult. Seepage into the refuse increases the risk of pollution of ground water.

In the trench type of landfill, ease of excavation also affects the suitability of a soil for this purpose, so the soil must be deep to bedrock and free of large stones and boulders. Where the seasonal water table is high, water seeps into trenches and causes problems in filling.

Unless otherwise stated, the limitations in table 12 apply only to the soil material within a depth of about 6 feet. If the trench is deeper, a limitation of slight or moderate may not be valid. Site investigation is needed before a site is selected.

Daily cover for landfill should be soil that is easy to excavate and spread over the compacted fill in wet and dry weather. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

The soils selected for final cover of landfills should be suitable for growing plants. Of all the horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

Where it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas. These factors include slope, erodibility, and potential for plant growth.

Construction Materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 13 by ratings of good, fair, or poor. The texture, thickness, and organic-matter content of each soil horizon are important factors in rating soils for use as construction materials. Each soil is evaluated to the depth observed, generally about 6 feet.

Roadfill is soil material used in embankments for roads. Soils are evaluated as a source of roadfill for low embankments, which generally are less than 6 feet high and less exacting in design than high embankments. The ratings reflect the ease of excavating and working the material and the expected performance of the material where it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about some of the soil properties that influence such performance is given in the descriptions of the soil series.

The ratings apply to the soil material between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within their profile. The estimated engineering properties in table 15 provide specific information about the nature of each horizon. This information can help determine the suitability of each horizon for roadfill.

Soils rated *good* are coarse grained. They have low shrink-swell potential, low potential frost action, and few cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated *fair* have a plasticity index of less than 15 and have other limiting features, such as moderate shrink-swell potential, moderately steep slopes, wetness, or many stones. If the thickness of suitable material is less than 3 feet, the entire soil is rated *poor*.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 13 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 15.

Topsoil is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material to support plantlife. Also considered is the damage that can result at the area from which the topsoil is taken.

The ease of excavation is influenced by the thickness of suitable material, wetness, slopes, and amount of stones. The ability of the soil to support plantlife is determined by texture, structure, and the amount of soluble salts or toxic substances. Organic matter in the A1 or Ap horizon greatly increases the absorption and retention of moisture and nutrients. Therefore, the soil material from these horizons should be carefully preserved for later use.

Soils rated *good* have at least 16 inches of friable loamy material at their surface. They are free of stones and cobbles, are low in content of gravel, and have gentle slopes. They are low in soluble salts that can limit or prevent plant growth. They are naturally fertile or respond well to fertilizer. They are not so wet that excavation is difficult during most of the year.

Soils rated *fair* are loose sandy soils or firm loamy or clayey soils in which the suitable material is only 8 to 16 inches thick or soils that have appreciable amounts of gravel, stones, or soluble salt.

Soils rated *poor* are very sandy soils and very firm clayey soils; soils with suitable layers less than 8 inches thick; soils having large amounts of gravel, stones, or soluble salt; steep soils; and poorly drained soils.

Although a rating of *good* is not based entirely on high content of organic matter, a surface horizon is generally preferred for topsoil because of its organic-matter content. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter.

Water Management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 14 the degree of soil limitation and soil and site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water control structures.

Soil and site limitations are expressed as slight, moderate, and severe. *Slight* means that the soil properties and site features are generally favorable for the specified use and that any limitation is minor and easily overcome. *Moderate* means that some soil properties or site features are unfavorable for the specified use but can be overcome or modified by special planning and design. *Severe* means that the soil properties and site features are so unfavorable and so difficult to correct or overcome that major soil reclamation, special design, or intensive maintenance is required.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have a low seepage potential, which is determined by permeability and the depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping and has favorable stability, shrink-swell potential, shear strength,

and compaction characteristics. Large stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes, and levees.

Aquifer-fed excavated ponds are bodies of water made by excavating a pit or dugout into a ground-water aquifer. Excluded are ponds that are fed by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Ratings in table 14 are for ponds that are properly designed, located, and constructed. Soil properties and site features that affect aquifer-fed ponds are depth to a permanent water table, permeability of the aquifer, quality of the water, and ease of excavation.

Drainage of soil is affected by such soil properties as permeability, texture, depth to bedrock, hardpan, or other layers that affect the rate of water movement, depth to the water table, slope, stability of ditchbanks, susceptibility to flooding, salinity and alkalinity, and availability of outlets for drainage.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to intercept runoff. They allow water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock, hardpan, or other unfavorable material; large stones; permeability; ease of establishing vegetation; and resistance to water erosion, soil blowing, soil slipping, and piping.

Grassed waterways are constructed to channel runoff to outlets at a nonerosive velocity. Features that affect the use of soils for waterways are slope, permeability, erodibility, wetness, and suitability for permanent vegetation.

Soil Properties

Extensive data about soil properties are summarized on the following pages. The two main sources of these data are the many thousands of soil borings made during the course of the survey and the laboratory analyses of selected soil samples from typical profiles.

In making soil borings during field mapping, soil scientists can identify several important soil properties. They note the seasonal soil moisture condition or the presence of free water and its depth. For each horizon in the profile, they note the thickness and color of the soil material; the texture, or amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or the natural pattern of cracks and pores in the undisturbed soil; and the consistence of the soil material in place under the existing soil moisture conditions. They record the depth of plant roots, determine the pH or reaction of the soil, and identify any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to determine all major properties of key soils, especially properties that cannot be estimated accurately by field observation. Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many soil series not tested are available from nearby survey areas.

The available field and laboratory data are summarized in tables. The tables give the estimated range of engineering properties, the engineering classification, and the physical and chemical properties of each major horizon of each soil in the survey area. They also present pertinent soil and water features, engineering test data, and data obtained from physical and chemical laboratory analyses of soils.

Engineering Properties

Table 15 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Table 15 gives information for each of these contrasting horizons in a typical profile. *Depth* to the upper and lower boundaries of each horizon is indicated. More information about the range in depth and about other properties in each horizon is given for each soil series in the section "Soil Series and Morphology."

Texture is described in table 15 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 soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified Soil Classification System (Unified) (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO) (*1*).

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, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example, CL-ML.

The *AASHTO* system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified in one of seven basic groups ranging 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. At the other extreme, in group A-7, are fine-grained soils. Highly organic soils are classified in group A-8 on the basis of visual inspection.

When laboratory data are available, the A-1, A-2, and A-7 groups are further classified as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested in the survey area, with group index numbers in parentheses, is given in table 18. The estimated classification, without group index numbers, is given in table 15. Also in table 15 the percentage, by weight, of rock fragments more than 3 inches in diameter is estimated for each major horizon. These estimates are determined mainly by observing volume percentage in the field and then converting that, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four sieves (U.S. standard) is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and *plasticity index* indicate the effect of water on the strength and consistence of soil. These indexes are used in both the Unified and AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior. Range in liquid limit and plasticity index are estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

In some surveys, the estimates are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterburg limits extend a marginal amount across classification boundaries (1 or 2 percent), the classification in the marginal zone is omitted in table 15.

Physical and Chemical Properties

Table 16 shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the typical pedon of each soil. The estimates are based on field observations and on test data for these and similar soils.

Permeability is estimated on the basis of known relationships among the soil characteristics observed in the field—particularly soil structure, porosity, and gradation or texture—that influence the downward movement of water in the soil. The estimates are for vertical water movement when the soil is saturated. Not considered in the estimates is lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in planning and designing drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed as range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops, ornamental plants, or other plants to be grown; in evaluating soil amendments for fertility and stabilization; and in evaluating the corrosivity of soils.

Salinity 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 the nonirrigated soils. The salinity of individual irrigated fields is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of individual fields can differ greatly from the value given in table 16. Salinity affects the suitability of a soil for crop production, its stability when used as a construction material, and its potential to corrode metal and concrete.

Shrink-swell potential depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others the swelling was estimated on the basis of the kind and amount of clay in the soil and on measurements of similar soils. The size of the load and the magnitude of the change in soil moisture content also influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used. A high shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

Risk of corrosion pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil material. The rate of corrosion of concrete is based mainly on the sulfate content, texture, and acidity of the soil. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Uncoated steel intersecting soil boundaries or soil horizons is more susceptible to corrosion than an installation that is entirely within one kind of soil or within one soil horizon.

Erosion factors are used to predict the erodibility of a soil and its tolerance to erosion in relation to specific kinds of land use and treatment. The soil erodibility factor (K) is a measure of the susceptibility of the soil to erosion by water. Soils having the highest K values are the most erodible. K values range from 0.10 to 0.64. To estimate annual soil loss per acre, the K value of a soil is modified by factors representing plant cover, grade and length of slope, management practices, and climate. The soil-loss tolerance factor (T) is the maximum rate of soil erosion, whether from rainfall or soil blowing, that can occur without reducing crop production or environmental quality. The rate is expressed in tons of soil loss per acre per year.

Soil and Water Features

Table 17 contains information helpful in planning land uses and engineering projects that are likely to be affected by soil and water features.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received 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 chiefly of deep, well drained to excessively drained sands or gravels. 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 to deep, moderately well drained to 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 that have a layer that impedes the downward movement of water or soils that have moderatly 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 clay soils 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 is the temporary covering of soil with water from overflowing streams, with runoff from adjacent slopes, and by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes is not considered flooding. Flooding is rated in general terms that describe the frequency and duration of flooding and the time of year when flooding is most likely. The ratings are based on evidence in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; and absence of distinctive soil horizons that form in soils of the area that are not subject to flooding. The ratings are also based on local information about floodwater levels in the area and the extent of flooding; and information that relates the position of each soil on the landscape to historic floods.

The generalized description of flood hazards is of value in land-use planning and provides a valid basis for land-use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table is the highest level of a saturated zone more than 6 inches thick for a continuous period of more than 2 weeks during most years. The depth to a seasonal high water table applies to undrained soils. Estimates are based mainly on the relationship between grayish colors or mottles in the soil and the depth to free water observed in many borings made during the course of the soil survey. Indicated are the depth to the seasonal high water table; the kind of water table, that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. Only saturated zones above a depth of 5 or 6 feet are indicated.

Information about the seasonal high water table helps in assessing the need for specially designed foundations, the need for specific kinds of drainage systems, and the need for footing drains to insure dry basements. Such information is also needed to decide whether or not construction of basements is feasible and to determine how septic tank absorption fields and other underground installations will function. Also, a seasonal high water table affects ease of excavation.

Depth to bedrock is shown for all soils that are underlain by bedrock at a depth of 5 to 6 feet or less. For many soils, the limited depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and on other observations during the soil mapping. The kind of bedrock and its hardness as related to ease of excavation is also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200-horsepower tractor, but hard bedrock generally requires blasting.

Test Data

Table 18 shows test data for some soils of Osage County that were tested by the State Highway Department. Test data for some of the other soils may be found in other published soil surveys. These tests were made to help evaluate surveys and to help evaluate the soils for engineering purposes. The engineering classifications given are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods.

Shrinkage limit is the percentage of moisture at which shrinkage of the soil material stops.

Shrinkage ratio is the relationship between the change in volume of the soil material and the water content of the soil material when at the shrinkage limit. The change in volume is expressed as a percentage of the air-dry volume of soil material, and the water content is expressed as a percentage of the weight of soil material when oven-dry.

The data on volume change indicate the amount of shrinkage and swelling that is obtained from the sample which is prepared at optimum moisture content and then subjected to drying and wetting. The total change that can occur in a specified soil is the sum of the value given for shrinkage and swelling.

Tests to determine liquid limit and plastic limit measure the effect of water on the consistence of soil material.

Classification of the Soils

In this section, the soil series recognized in the survey area are described, the current system of classifying soils is defined, and the soils in the area are classified according to the current system.

Soil Series and Morphology

In this section, each soil series recognized in the survey area is described in detail. The descriptions are arranged in alphabetic order by series name.

Characteristics of the soil and the material in which it formed are discussed for each series. The soil is compared to similar soils and to nearby soils of other series. A pedon, a small three-dimensional area of soil typical of the soil series in the survey area, is described. The detailed descriptions of each soil horizon follow standards in the Soil Survey Manual (*3*). Unless otherwise noted, colors described are for moist soil.

Following the pedon description is the range of important characteristics of the soil series in this survey area. Phases, or mapping units, of each soil series are described in the section "Soil Map for Detailed Planning."

Apperson Series

The Apperson series consists of deep, nearly level through very gently sloping soils on uplands. These soils formed in material weathered from limestone and thin layers of chert under a cover of grasses.

The Apperson soils are moderately well drained and have slow permeability. Available water capacity is medium.

Typical pedon of Apperson silty clay loam, in an area of Apperson-Dwight complex, 0 to 3 percent slopes, 165 feet north and 160 feet east of the southwest corner, sec. 21, T. 29 N., R. 7 E.:

A1—0 to 12 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; strong coarse granular structure; hard, firm; medium acid; clear smooth boundary.

B1—12 to 16 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to strong coarse granular; hard, firm; medium acid; clear smooth boundary.

B21t—16 to 21 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; few fine distinct light olive brown mottles; moderate fine and medium subangular blocky structure; very hard, very firm; nearly continuous clay films or pressure faces on faces of peds; slightly acid; gradual smooth boundary.

B22t—21 to 26 inches; very dark grayish brown (2.5Y 3/2) silty clay, dark grayish brown (2.5Y 4/2) dry; many fine distinct black (10YR 2/1), gray (10YR 5/1), and olive brown (2.5Y 4/4) mottles; weak fine blocky structure; extremely hard, extremely firm; nearly continuous clay films or pressure faces on faces of peds; few chert fragments less than 3 inches in diameter; mildly alkaline; gradual smooth boundary.

B23t—26 to 33 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; many medium distinct gray (10YR 5/1), olive yellow (2.5Y 6/6), and light olive brown (2.5Y 5/6) mottles; weak fine blocky structure; extremely hard, extremely firm; nearly continuous clay films or pressure faces on faces of peds; few chert fragments less than 3 inches in diameter; moderately alkaline; gradual smooth boundary.

B3—33 to 46 inches; dark grayish brown (2.5Y 4/2) silty clay, light brownish gray (2.5Y 6/2) dry; many medium distinct gray (10YR 5/1) and olive brown (2.5Y 4/4) mottles; weak coarse blocky structure; extremely hard, extremely firm; few slickensides; few chert fragments less than 3 inches in diameter; moderately alkaline; abrupt irregular boundary.

R—46 to 48 inches; hard grayish limestone bedrock.

The solum is 40 to 60 inches thick over hard limestone bedrock. Depth to the water table is 1 1/2 to 2 feet. Cracks extend from the surface into the B horizon during dry seasons.

The A1 or Ap horizon is black or very dark gray. Reaction is medium acid through slightly acid except in limed areas.

The B1 horizon is black, very dark gray, or very dark grayish brown silty clay loam or silty clay. Reaction ranges from medium acid through mildly alkaline.

The B21t horizon is black, very dark brown, very dark gray, very dark grayish brown, or dark gray. Some pedons are mottled in shades of brown or red. Reaction ranges from slightly acid through mildly alkaline.

The B22t and B23t horizons are very dark gray, dark gray, very dark grayish brown, or dark brown. Most pedons are mottled in shades of gray, black, brown, yellow, gray, or red. Streaks of black soil material extend vertically into these horizons in many pedons. Reaction ranges from slightly acid through moderately alkaline. In most pedons, the B2t and B3 horizons have slickensides that do not intersect, fine black concretions, and calcium carbonate concretions. Chert or limestone fragments and calcium carbonate concretions less than 3 inches in diameter make up 0 to 5 percent of the volume of the B2t horizon.

The B3 horizon is dark grayish brown, grayish brown, brown, dark brown, dark yellowish brown, yellowish brown, olive brown, or light olive brown. Most pedons are mottled in shades of gray, brown, yellow, or red. Reaction ranges from slightly acid through moderately alkaline. Chert or limestone fragments and calcium carbonate concretions less than 3 inches in diameter make up from 0 to 10 percent of the volume.

Apperson soils are on ridge crests and are associated on the same landscape with Shidler, Dwight, Okemah, Summit, and Wolco soils. Apperson soils have a thicker solum than that of Shidler soils. They do not have the abrupt textural change between the A and B horizons and the high sodium content of the B horizon common to Dwight soils. Apperson soils are similar to Summit and

Okemah soils, but they have bedrock within 60 inches of the surface. They are darker than Wolco soils, and they crack when dry.

Barnsdall Series

The Barnsdall series consists of deep, nearly level soils on flood plains. These soils formed in loamy sediments under a cover of trees and grasses. They are subject to flooding.

The Barnsdall soils are well drained and have moderate permeability. Available water capacity is high.

Typical pedon of Barnsdall very fine sandy loam, 1,550 feet east and 750 feet north of the southwest corner, sec. 29, T. 22 N., R. 10 E.:

Ap—0 to 7 inches; dark brown (10YR 4/3) very fine sandy loam, brown (10YR 5/3) dry; weak fine granular structure; slightly hard, very friable; neutral; abrupt smooth boundary.

A2—7 to 11 inches; brown (7.5YR 5/4) very fine sandy loam, light brown (7.5YR 6/4) dry; weak fine granular structure; slightly hard, very friable; neutral; clear smooth boundary.

B21t—11 to 29 inches; reddish brown (5YR 4/4) silty clay loam, reddish brown (5YR 5/4) dry; moderate fine and medium subangular blocky structure; hard, friable; nearly continuous clay films on faces of peds; few brown coatings of material similar to material from the A2 horizon are on vertical faces of peds; slightly acid; gradual smooth boundary.

B22t—29 to 45 inches; reddish brown (5YR 4/3) silty clay loam, reddish brown (5YR 5/4) dry; weak medium subangular blocky structure; hard, friable; nearly continuous clay films on faces of peds; few brown coatings of material similar to material from the A2 horizon are on vertical faces of peds; few fine black concretions; medium acid; gradual smooth boundary.

B3—45 to 58 inches; reddish brown (5YR 4/3) clay loam, reddish brown (5YR 5/3) dry; weak medium subangular blocky structure; hard, friable; patchy clay films on faces of peds; few fine black concretions; strongly acid; gradual smooth boundary.

IIC—58 to 72 inches; brown (7.5YR 4/4) fine sandy loam, brown (7.5YR 5/4) dry; massive; hard, friable; few fine black concretions; strongly acid.

The solum is 40 to 60 inches thick or more. Depth to bedrock is more than 60 inches. Depth to the water table is more than 6 feet.

The Ap or A1 horizon is very dark grayish brown, dark grayish brown, dark brown, or brown. Reaction ranges from medium acid through neutral except in limed areas.

The A2 horizon is brown or dark brown. Reaction ranges from medium acid through neutral except in limed areas.

The B2t horizon is reddish brown or yellowish red clay loam or silty clay loam. Reaction ranges from strongly acid through neutral.

The B3 horizon is brown, strong brown, reddish brown, or yellowish red loam, clay loam, or silty clay loam. Reaction ranges from strongly acid through medium acid.

The IIC horizon is brown or strong brown. Some pedons are mottled in shades of brown. The texture is fine sandy loam or clay loam. Reaction ranges from strongly acid through medium acid. Some pedons have buried horizons below a depth of 40 inches.

Barnsdall soils are on slightly convex flood plains and are associated on the same landscape with Mason and Verdigris soils. They have a lighter colored A horizon and a more reddish B or C horizon than those of Mason and Verdigris soils.

Bates Series

The Bates series consists of moderately deep, very gently sloping through sloping soils on uplands. These soils formed in material weathered from sandstone under a cover of grasses.

The Bates soils are well drained and have moderate permeability. Available water capacity is medium.

Typical pedon of Bates loam, 1 to 3 percent slopes, 200 feet south and 50 feet west of the northeast corner, sec. 9, T. 27 N., R. 8 E.:

A1—0 to 10 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; slightly hard, very friable; medium acid; gradual smooth boundary.

B1—10 to 16 inches; dark brown (7.5YR 4/2) loam, brown (7.5YR 5/2) dry; few fine distinct strong brown mottles; weak medium subangular blocky structure parting to moderate medium granular; hard, friable; few worm casts; medium acid; gradual smooth boundary.

B2t—16 to 24 inches; dark brown (7.5YR 4/4) clay loam, brown (7.5YR 5/4) dry; few medium distinct yellowish red (5YR 4/6) mottles; weak medium subangular blocky structure; very hard, friable; patchy clay films on faces of peds; few sandstone fragments less than 3 inches in diameter; medium acid; gradual smooth boundary.

B3—24 to 36 inches; yellowish brown (10YR 5/4) sandy clay loam, light yellowish brown (10YR 6/4) dry; common medium distinct red (2.5YR 5/8) mottles; weak medium subangular blocky structure; hard, friable; patchy clay films on faces of peds; about 30 percent, by volume, sandstone fragments less than 3 inches in diameter; medium acid; gradual irregular boundary.

Cr—36 to 40 inches; strong brown (7.5YR 5/6) and red (2.5YR 4/6) soft acid sandstone.

These soils are 20 to 40 inches thick over sandstone bedrock. Depth to the water table is more than 6 feet.

The A1 or Ap horizon is very dark brown, very dark grayish brown, or dark brown. Reaction ranges from medium acid through slightly acid except in limed areas.

The B1 horizon is brown, dark brown, very dark grayish brown, or dark grayish brown loam, clay loam, or sandy clay loam. Reaction ranges from medium acid through slightly acid.

The B2t horizon is brown, dark brown, strong brown, dark yellowish brown, or yellowish brown. Some pedons are mottled in shades of red, yellow, or brown. The texture is sandy clay loam or clay loam. Reaction ranges from medium acid through strongly acid. Sandstone fragments less than 3 inches in diameter make up from 0 to 25 percent of the volume.

The B3 horizon is brown, strong brown, or yellowish brown. Mottles are in shades of gray, brown, yellow, or red. The texture is loam, clay loam, or sandy clay loam. Reaction ranges from strongly acid through slightly acid. Sandstone fragments less than 3 inches in diameter make up from 0 to 35 percent, by volume, of this horizon.

The Cr horizon consists of brownish, yellowish, or reddish sandstone interbedded in some pedons with lenses of grayish shales.

Bates soils are on crests and side slopes and are associated on the same landscape with Coweta, Dennis, Steedman, and Prue soils. Coweta soils do not have argillic horizons and Dennis and Steedman soils have a clayey soil material in the control section. Prue soils have a thicker solum than that of the Bates soils.

Carytown Series

The Carytown series consists of deep, nearly level through very gently sloping soils on uplands. These soils formed in material weathered from shales interbedded with thin layers of sandstone under a cover of grasses.

The Carytown soils are poorly drained and have very slow permeability. Available water capacity is low.

Typical pedon of Carytown silt loam, in an area of Dennis-Carytown complex, 1 to 5 percent slopes, 1,300 feet south and 1,250 feet east of the center of sec. 33, T. 25 N., R. 9 E.:

A1—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine and medium granular structure; slightly hard, very friable; medium acid; abrupt smooth boundary.

B21tg—9 to 18 inches; very dark grayish brown (10YR 3/2) silty clay, grayish brown (10YR 5/2) dry; common fine distinct strong brown mottles; moderate medium columnar structure parting to moderate medium blocky; very hard, very firm; nearly continuous clay films on faces of peds; grayish coatings on faces of some peds; slightly acid; gradual smooth boundary.

B22tg—18 to 33 inches; dark grayish brown (10YR 4/2) silty clay, grayish brown (10YR 5/2) dry; few fine distinct strong brown mottles; moderate medium and coarse blocky structure; extremely hard, very firm; nearly continuous clay films on faces of peds; few fine black concretions; moderately alkaline; gradual smooth boundary.

B23t—33 to 38 inches; dark brown (10YR 4/3) silty clay, brown (10YR 5/3) dry; common fine distinct strong brown mottles; weak medium blocky structure; very hard, very firm; nearly continuous dark grayish brown (10YR 4/2) clay films on faces of peds; few fine black concretions; many soft masses of soluble salts; moderately alkaline; gradual smooth boundary.

B31—38 to 57 inches; coarsely mottled gray (10YR 5/1), strong brown (7.5YR 4/6), and very dark brown (10YR 2/2) silty clay; weak coarse blocky structure; very hard, very firm; patchy clay films on faces of peds; many fine black concretions; moderately alkaline; gradual smooth boundary.

B32—57 to 72 inches; coarsely mottled light brownish gray (10YR 6/2), dark gray (10YR 4/1), and strong brown (7.5YR 5/6) silty clay; weak coarse blocky structure; very hard, very firm; patchy clay films on faces of peds; mildly alkaline.

The thickness of the solum and depth to bedrock is 40 to more than 60 inches. Depth to the water table ranges from 0 to 1 foot.

The A1 or Ap horizon is very dark gray or very dark grayish brown. Some pedons are mottled in shades of brown, red, or yellow. Reaction ranges from medium acid through slightly acid except in limed areas. Some pedons have a thin, lighter colored A2 horizon.

The B21tg horizon is very dark brown, very dark grayish brown, or dark brown. Most pedons are mottled in shades of gray, red, or yellow. The texture is silty clay loam or silty clay. Reaction ranges from medium acid through moderately alkaline. The peds in many places have grayish coatings or black stains. Exchangeable sodium is more than 15 percent.

The lower part of the B2tg horizon and the B2t horizon are dark grayish brown, brown, dark brown, dark yellowish brown, or olive brown mottled in shades of red, yellow, gray, or brown. Textures are silty clay or clay. Reaction ranges from neutral through moderately alkaline. Some pedons have slickensides. Soluble salts occur in soft masses or threadlike forms.

The B3 horizon is coarsely mottled in shades of gray, brown, yellow, or red. The texture is silty clay or clay. Reaction ranges from neutral through moderately alkaline. This horizon is 0 to 30 percent, by volume, shale or sandstone fragments. Some pedons have slickensides.

In Osage County, Carytown soils are mapped only in complex with Dennis and Parsons soils.

Carytown soils are in concave depressions and are associated on the same landscape with Dennis and Parsons soils. They have a higher amount of exchangeable sodium in the upper argillic horizon than that of Dennis and Parsons soils.

These soils are taxadjuncts to the Carytown series because they do not have an A2 horizon and they have a thinner A horizon than allowed in the range for the Carytown series.

Catoosa Series

The Catoosa series consists of moderately deep, very gently sloping soils on uplands. These soils formed in material weathered from limestone under a cover of grasses.

The Catoosa soils are well drained and have moderate permeability. Available water capacity is medium.

Typical pedon of Catoosa silt loam, in an area of Catoosa-Shidler complex, 1 to 3 percent slopes, 2,700 feet north and 720 feet west of the southeast corner, sec. 12, T. 25 N., R. 8 E.:

A1—0 to 9 inches; dark brown (7.5YR 3/2) silt loam, brown (7.5YR 4/2) dry; moderate medium granular structure; hard, friable; slightly acid; clear smooth boundary.

B1—9 to 13 inches; dark reddish brown (5YR 3/2) silty clay loam, dark reddish gray (5YR 4/2) dry; moderate fine subangular blocky structure parting to moderate medium granular; hard, firm; slightly acid; clear smooth boundary.

B21t—13 to 21 inches; dark reddish brown (5YR 3/4) silty clay loam, reddish brown (5YR 4/4) dry; moderate medium subangular blocky structure parting to moderate medium granular; very hard, very firm; patchy clay films on faces of peds; common worm casts; neutral; gradual smooth boundary.

B22t—21 to 30 inches; dark reddish brown (5YR 3/4) silty clay loam, reddish brown (5YR 4/4) dry; moderate medium blocky structure; very hard, very firm; nearly continuous clay films on faces of peds; common worm casts; neutral; abrupt irregular boundary.

R—30 to 32 inches; grayish, coarsely fractured, hard limestone; fractures filled with soil material similar to material from horizon above; the bedrock has bedding planes 2 to 6 inches apart.

These soils are 20 to 40 inches thick over hard limestone bedrock. Depth to the water table is more than 6 feet.

The A1 or Ap horizon is very dark brown, dark brown, or very dark grayish brown. Reaction ranges from medium acid through slightly acid except in limed areas.

The B1 horizon is dark reddish brown, dark brown, dark reddish gray, reddish brown, or brown silt loam or silty clay loam. Reaction ranges from medium acid through slightly acid.

The B2t horizon is dark reddish brown, brown, dark brown, or reddish brown. Reaction ranges from medium acid through neutral. The lower part of the B2t horizon is 0 to 35 percent, by volume, chert or limestone fragments, mostly less than 3 inches in diameter.

Catoosa soils are on crests and in valleys and are associated on the same landscape with Shidler and Lula soils. Shidler soils do not have the argillic horizons that are present in Catoosa soils. Lula soils have a thicker solum than that of Catoosa soils.

Choska Series

The Choska series consists of deep, nearly level soils on flood plains. These soils formed in loamy sediments under a cover of trees with an understory of grasses. They are subject to flooding.

The Choska soils are well drained and have moderate permeability. Available water capacity is high.

Typical pedon of Choska very fine sandy loam, 750 feet east and 20 feet north of the southwest corner, sec. 35, T. 24 N., R. 4 E.:

Ap—0 to 9 inches; dark brown (10YR 3/3) very fine sandy loam, brown (10YR 5/3) dry; weak medium platy structure parting to weak fine granular; slightly hard, very friable; neutral; clear smooth boundary.

C1—9 to 22 inches, brown (10YR 4/3) very fine sandy loam, brown (10YR 5/3) dry; massive; slightly hard, very friable; mildly alkaline; clear wavy boundary.

C2—22 to 40 inches; brown (7.5YR 4/4) very fine sandy loam, brown (7.5YR 5/4) dry; massive; hard, very friable; evident bedding planes; moderately alkaline; clear wavy boundary.

C3—40 to 65 inches; brown (7.5YR 5/4) very fine sandy loam, pink (7.5YR 7/4) dry; massive; hard, friable; stratified with thin lenses of silty clay loam; calcareous; moderately alkaline.

These soils are more than 60 inches thick to bedrock. Depth to the water table is more than 6 feet.

The Ap or A1 horizon is dark brown or very dark grayish brown. Reaction ranges from slightly acid through neutral.

The C horizon is reddish brown, yellowish red, brown, or strong brown very fine sandy loam or silt loam. Thin strata of soil materials ranging from silty clay loam to loamy fine sand are within 40 inches of the surface in most pedons. Below a depth of 40 inches, strata of clay, silty clay, or fine sand are sometimes present. Reaction ranges from neutral through moderately alkaline.

Choska soils are on convex flood plains and are associated on the same landscape with Kiomatia soils. Kiomatia soils have a more sandy control section than Choska soils.

Cleora Series

The Cleora series consists of deep, nearly level through very gently sloping soils on flood plains. These soils formed in loamy sediments under a cover of trees with an understory of grasses. They are subject to flooding.

The Cleora soils are well drained and have moderately rapid permeability. Available water capacity is medium.

Typical pedon of Cleora fine sandy loam, 1,600 feet west and 25 feet north of the southeast corner, sec. 2, T. 23 N., R. 8 E.:

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak fine granular structure; slightly hard, very friable; few worm casts; limed field; neutral; clear smooth boundary.

A1—6 to 12 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak medium granular structure; slightly hard, very friable; few worm casts; neutral; gradual smooth boundary.

AC—12 to 25 inches; dark brown (10YR 4/3) fine sandy loam, brown (10YR 5/3) dry; weak coarse subangular blocky structure; slightly hard, very friable; few worm casts; neutral; gradual smooth boundary.

C1—25 to 53 inches; dark yellowish brown (10YR 4/4) fine sandy loam, yellowish brown (10YR 5/4) dry; massive; slightly hard, very friable; few thin strata of lighter colored loamy fine sand; neutral; clear wavy boundary.

C2—53 to 60 inches; yellowish brown (10YR 5/4) loamy fine sand, light yellowish brown (10YR 6/4) dry; single grained; loose, very friable; thin strata of darker colored loamy material; neutral.

These soils are more than 60 inches thick to bedrock. Depth to the water table is more than 6 feet. In undulating areas, the A horizon is thicker and darker in the concave parts of the landscape. Reaction ranges from medium acid through neutral except in limed areas.

The Ap or A1 horizon is very dark brown, very dark grayish brown, or dark brown.

The AC horizon is brown, dark brown, dark yellowish brown, or yellowish brown. Thin strata of darker or lighter colored soil materials are in this horizon in some pedons. The texture is loam or fine sandy loam and some pedons have thin strata of finer or coarser textured material.

The C horizon is brown, dark brown, dark yellowish brown, or yellowish brown fine sandy loam or loamy fine sand. Strata of finer or coarser textured material are present in most pedons. Buried horizons of dark colored silt loam or silty clay loam are below a depth of 40 inches in many pedons.

Cleora soils are on convex flood plains and are associated on the same landscape with Verdigris soils. Verdigris soils have a more clayey control section than Cleora soils.

Corbin Series

The Corbin series consists of deep, very gently sloping through gently sloping soils on uplands. These soils formed in material weathered from shales, sandstones, and clayey sediments under a cover of grasses.

The Corbin soils are well drained and have slow permeability. Available water capacity is high.

Typical pedon of Corbin silt loam, in an area of Corbin-Pawhuska complex, 1 to 5 percent slopes, 1,160 feet south and 10 feet east of the northwest corner of sec. 17, T. 25 N., R. 5 E.:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine platy structure parting to weak medium granular; hard, friable; many fine and medium roots; few medium pores; many worm casts; slightly acid; clear smooth boundary.

A1—8 to 14 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; hard, friable; many fine and many medium roots; many fine and few medium pores; many worm casts; slightly acid; clear smooth boundary.

B1—14 to 20 inches; dark brown (10YR 3/3) silty clay loam, brown to dark brown (10YR 4/3) dry; common fine distinct yellowish red mottles; moderate medium prismatic structure parting to strong medium granular; hard, firm; common fine and common medium roots; many fine and few medium pores; patchy clay films on faces of peds; slightly acid; gradual smooth boundary.

B21t—20 to 27 inches; reddish brown (5YR 4/3) silty clay loam, reddish brown (5YR 5/3) dry; common fine and medium distinct yellowish red (5YR 4/6) mottles; weak medium prismatic structure parting to strong medium granular; very hard, very firm; common fine and few medium roots; common fine and few medium pores; nearly continuous clay films on faces of peds; slightly acid; gradual wavy boundary.

B22t—27 to 40 inches; reddish brown (5YR 4/3) silty clay, reddish brown (5YR 5/3) dry; many coarse distinct yellowish red (5YR 5/6) mottles; moderate medium blocky structure; extremely hard, very firm; common fine and few medium roots; common fine pores; nearly continuous clay films on faces of peds; many fine black concretions; black stains on faces of some peds; neutral; gradual smooth boundary.

B23t—40 to 50 inches; reddish brown (5YR 4/4) silty clay, reddish brown (5YR 5/4) dry; common coarse distinct yellowish red (5YR 5/6) mottles and few fine distinct grayish brown mottles; moderate medium blocky structure; extremely hard, very firm; few fine roots; few fine pores; nearly continuous clay films on faces of peds; common slickensides; many fine black concretions; black stains in root channels; few krotovinas; few soft masses of calcium carbonate; moderately alkaline; gradual smooth boundary.

B24tca—50 to 63 inches; reddish brown (5YR 4/4) silty clay, reddish brown (5YR 5/4) dry; many coarse distinct yellowish red (5YR 5/6) mottles and common medium distinct grayish brown (10YR 5/2) mottles; weak medium blocky structure; extremely hard, very firm; few fine roots; few fine pores; nearly continuous clay films on faces of peds; common fine black concretions; black stains in root channels; common medium and coarse calcium carbonate concretions; calcareous; moderately alkaline; gradual smooth boundary.

B3—63 to 73 inches; coarsely mottled reddish brown (5YR 4/4), brown to dark brown (7.5YR 4/4), dark brown (7.5YR 3/2), brownish yellow (10YR 6/8), brown (10YR 5/3), and light brownish gray (2.5Y 6/2) silty clay loam; weak coarse blocky structure; very hard, firm; few fine roots; common fine pores; patchy clay films on faces of peds; few fine black concretions; calcareous; moderately alkaline; gradual smooth boundary.

C1—73 to 81 inches; coarsely mottled reddish brown (5YR 4/4, 5/3), light brown (7.5YR 6/4), light reddish brown (2.5YR 6/4), yellowish brown (10YR 5/6), and brown (10YR 5/3) silty clay loam; massive; very hard, firm; common fine and few medium pores; moderately alkaline; gradual smooth boundary.

These soils are more than 60 inches thick. Depth to the water table ranges from 4 to 5 feet.

The Ap or A1 horizon is very dark brown, black, very dark gray, dark brown, or very dark grayish brown. Reaction ranges from medium acid through slightly acid except in limed areas.

The B1 horizon is very dark gray, very dark brown, very dark grayish brown, dark brown, or dark reddish brown. Some pedons have reddish or brownish mottles. Reaction ranges from medium acid through slightly acid.

The B2t horizon color is dark reddish brown, reddish brown, brown, or dark brown. Most pedons are mottled in shades of red, brown, or gray. The texture is silty clay loam or silty clay. Reaction ranges from slightly acid through moderately alkaline. The lower part of the B2t horizon is calcareous in some pedons.

The B3 horizon is commonly coarsely mottled in shades of red, yellow, brown, or gray. Some pedons have dominant matrix colors of dark reddish brown, dark reddish gray, or reddish brown with mottles similar to those mentioned above. The texture is silty clay loam or silty clay. Reaction ranches from neutral through moderately alkaline. This horizon contains from 0 to 20 percent, by volume, of coarse fragments less than 3 inches in diameter.

The C horizon is red, yellow, brown, or gray fine grained sandstone or loamy or clayey sediments.

Corbin soils are on crests and side slopes and are associated on the same landscape with Pawhuska, Norge, Grainola, and Lucien soils. Pawhuska soils have more exchangeable sodium content in the upper part of the argillic horizon than that of Corbin soils; Norge soils are fine silty throughout the B horizon; Grainola soils have a clayey control section; and Lucien soils do not have argillic horizons.

These soils are taxadjuncts to the Corbin series because the lower part of the argillic horizon has colors in hue of 5YR, which is outside the range of the series.

Coweta Series

The Coweta series consists of shallow, gently sloping through steep soils on uplands. These soils formed in material weathered from sandstone under a cover of grasses.

The Coweta soils are well drained to somewhat excessively drained and have moderate permeability. Available water capacity is low.

Typical pedon of Coweta loam, in an area of Coweta-Bates complex, 1 to 8 percent slopes, 2,540 feet south and 2,300 feet east of the northwest corner, sec. 4, T. 24 N., R. 12 E.:

A1—0 to 9 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; slightly hard, very friable; medium acid; clear smooth boundary.

B2—9 to 16 inches; dark brown (7.5YR 3/2) loam, brown (7.5YR 4/2) dry; moderate fine granular structure; slightly hard, very friable; about 15 percent weathered sandstone fragments less than 3 inches in diameter; slightly acid; abrupt irregular boudary.

Cr—16 to 20 inches; strong brown (7.5YR 5/6) and very dark brown (10YR 2/2) soft acid sandstone bedrock.

These soils are 10 to 20 inches thick over sandstone bedrock. Depth to the water table is more than 6 feet. Reaction ranges from medium acid through slightly acid.

The A1 horizon is dark brown or very dark grayish brown. It has from 0 to 15 percent, by volume, coarse fragments less than 3 inches in diameter and from 0 to 5 percent, by volume, coarse fragments more than 3 inches in diameter.

The B2 horizon is brown, dark brown, or dark grayish brown loam or fine sandy loam. It has from 0 to 25 percent, by volume, coarse fragments less than 3 inches in diameter and from 0 to 10 percent, by volume, coarse fragments more than 3 inches in diameter.

The Cr horizon is reddish, brownish, or yellowish sandstone. In many pedons, it is interbedded with thin lenses of grayish shales.

Coweta soils are on crests and upper slopes and are associated on the same landscape with Bates and Steedman soils. Bates and Steedman soils have argillic horizons, and Coweta soils do not.

Darnell Series

The Darnell series consists of shallow, very gently sloping through steep soils on uplands. These soils formed in material weathered from sandstone under a cover of trees with an understory of grasses.

The Darnell soils are well drained to somewhat excessively drained and have moderately rapid permeability. Available water capacity is low.

Typical pedon of Darnell fine sandy loam, in an area of Darnell-Stephenville complex, 1 to 8 percent slopes, 300 feet east and 20 feet north of the southwest corner, sec. 23, T. 27 N., R. 10 E.:

A1—0 to 4 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak medium granular structure; slightly hard, very friable; about 2 percent stones from 3 to 10 inches in diameter; medium acid; clear smooth boundary.

B2—4 to 12 inches; dark brown (7.5YR 4/4) fine sandy loam, brown (7.5YR 5/4) dry; weak medium granular structure; slightly hard, very friable; medium acid; clear irregular boundary.

Cr—12 to 14 inches; strong brown (7.5YR 5/8), red (2.5YR 4/6), and light yellowish brown (2.5Y 6/4) soft, fine grained acid sandstone bedrock.

Some phases are stony. The depth to sandstone bedrock is 10 to 20 inches. Depth to the water table is more than 6 feet.

The A1 horizon is dark brown, very dark brown, or very dark grayish brown. Reaction ranges from medium acid through slightly acid except in limed areas. Sandstone fragments less than 3 inches in diameter occupy as much as 5 percent, by volume, of this horizon and fragments 3 to 12 inches in diameter occupy as much as 15 percent, by volume.

The B2 horizon is brown, dark brown, light brown, grayish brown, or pale brown. Reaction ranges from strongly acid through medium acid

except in limed areas. Sandstone fragments less than 3 inches in diameter occupy as much as 20 percent, by volume, of this horizon and fragments larger than 3 inches occupy as much as 5 percent, by volume.

The Cr horizon ranges from red to light yellowish brown.

Darnell soils are on crests and upper slopes and are associated on the same landscape with Stephenville and Niotaze soils. Stephenville and Niotaze soils have argillic horizons; Darnell soils do not.

Dennis Series

The Dennis series consists of deep, very gently sloping through gently sloping soils on uplands. These soils formed in material weathered from shales interbedded with thin layers of sandstone under a cover of grasses.

The Dennis soils are moderately well drained and have slow permeability. Available water capacity is high.

Typical pedon of Dennis silt loam, 1 to 3 percent slopes, 700 feet east and 650 feet north of the southwest corner, sec. 17, T. 24 N., R. 7 E.:

A1—0 to 13 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium granular; slightly hard, friable; medium acid; gradual smooth boundary.

B1—13 to 20 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 4/3) dry; few fine distinct strong brown and very dark grayish brown mottles; weak medium subangular blocky structure parting to moderate medium granular structure; hard, friable; medium acid; gradual smooth boundary.

B21t—20 to 32 inches; brown (10YR 4/3) silty clay loam, brown (10YR 5/3) dry; common medium distinct yellowish red (5YR 4/6) and few fine distinct strong brown and grayish brown mottles; moderate medium blocky structure parting to moderate medium granular; very hard, firm; nearly continuous clay films on faces of peds; many fine black concretions; slightly acid; gradual smooth boundary.

B22t—32 to 42 inches; brown (10YR 4/3) silty clay, brown (10YR 5/3) dry; many coarse distinct yellowish red (5YR 4/6) and dark grayish brown (10YR 4/2) mottles and common medium distinct strong brown (7.5YR 5/6) mottles; moderate medium and coarse blocky structure; extremely hard, very firm; nearly continuous clay films on faces of peds; many fine black concretions; slightly acid; gradual smooth boundary.

B23t—42 to 62 inches; coarsely mottled dark grayish brown (10YR 4/2), strong brown (7.5YR 5/6), grayish brown (10YR 5/2), and yellowish red (5YR 4/6) silty clay; weak coarse blocky structure; extremely hard, very firm; nearly continuous clay films on faces of peds; many fine black concretions; slightly acid.

The thickness of the solum and depth to bedrock is more than 60 inches. Depth to the water table ranges from 1.5 to 3 feet.

The A1 or Ap horizon is very dark brown or very dark grayish brown.

Some pedons have an A2 horizon, as much as 4 inches thick, that has colors grayer or browner than the A1 horizon and textures and reaction similar to the B1 horizon.

The B1 horizon is very dark grayish brown, brown, or dark brown. Most pedons are mottled in shades of red, brown, or yellow.

The upper part of the B2t horizon is brown, dark brown, or dark yellowish brown mottled in shades of red, yellow, brown, or gray. The texture is silty clay loam or silty clay. Reaction ranges from medium acid through slightly acid.

The lower part of the B2t horizon and the B3 horizon, where present, are commonly coarsely mottled in shades of red, yellow, brown, gray, or black. The texture is silty clay loam or silty clay. Some pedons have slickensides within these horizons. In places, these horizons contain as much as 30 percent, by volume, sandstone or shale fragments less than 3 inches in diameter.

Some pedons have a Cr horizon, which has colors and textures similar to those of the lower part of the B2t or the B3 horizon before grading into laminated grayish shales interbedded with sandstone. The Cr horizon ranges from neutral through moderately alkaline.

Dennis soils are on side slopes and valleys and are associated on the same landscape with Bates, Carytown, Okemah, Pawhuska, Parsons, and Steedman soils. Bates and Steedman soils have a less thick solum than that of Dennis soils. Carytown and Pawhuska soils have a higher amount of exchangeable sodium in the upper part of the argillic horizon than that of the Dennis soils. Okemah soils have darker colors in the upper part of the solum than those of the Dennis soils. Parsons soils have an abrupt textural change between the A and B horizons.

Dougherty Series

The Dougherty series consists of deep, nearly level through sloping soils on uplands. These soils formed in sandy and loamy sediments under a cover of trees with an understory of grasses.

The Dougherty soils are well drained and have moderate permeability. Available water capacity is medium.

Typical pedon of Dougherty loamy fine sand, 1 to 3 percent slopes, 1,840 feet north and 240 feet west of the southeast corner, sec. 11, T. 23 N., R. 3 E.:

A1—0 to 7 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak medium granular structure; soft, very friable; reaction higher than normal because of dust from graveled road; slightly acid; clear smooth boundary.

A2—7 to 24 inches; brown (10YR 4/3) loamy fine sand, pale brown (10YR 6/3) dry; massive; soft, very friable; slightly acid; clear smooth boundary.

B2t—24 to 36 inches; reddish brown (5YR 4/4) sandy clay loam, reddish brown (5YR 5/4) dry; moderate medium subangular blocky structure; very hard, firm; nearly continuous clay films on faces of peds; grayish coatings similar to material in A2 horizon on surface of some peds; strongly acid; gradual smooth boundary.

B3—36 to 55 inches; yellowish red (5YR 4/6) sandy clay loam; yellowish red (5YR 5/6) dry; weak medium subangular blocky structure; very hard, firm; patchy clay films on faces of peds; medium acid; gradual smooth boundary.

C—55 to 62 inches; yellowish red (5YR 5/6) loamy fine sand, reddish yellow (5YR 6/6) dry; massive; slightly hard, very friable; slightly acid.

These soils have an A horizon 20 to 40 inches thick and a solum more than 40 inches thick. Depth to bedrock is more than 60 inches. Depth to the water table is more than 6 feet.

The A1 horizon or Ap horizon is dark brown, very dark grayish brown, or brown. Reaction ranges from medium acid through slightly acid except in limed areas.

The A2 horizon is brown, dark grayish brown, light brown, or pale brown loamy fine sand or fine sand. Reaction ranges from medium acid through slightly acid.

The B2t horizon is reddish brown or yellowish red. Reaction ranges from strongly acid through medium acid.

The B3 and C horizons have colors similar to those of the B2t horizon. The texture of the B3 horizon is fine sandy loam or sandy clay loam. Reaction in the B3 horizon ranges from strongly acid through slightly acid. Reaction in the C horizon ranges from medium acid through neutral.

Dougherty soils are on crests and side slopes and are associated on the same landscape with Eufaula, Gasil, and Konawa soils. Eufaula soils have a more sandy argillic

horizon than that of the Dougherty soils. The A horizon in Gasil and Konawa soils is less thick than the A horizon in Dougherty soils.

Drummond Series

The Drummond series consists of nearly level, slightly depressional soils on flood plains. These soils formed in clayey and loamy sediments under a cover of grasses. They are subject to flooding.

The Drummond soils are somewhat poorly drained and have very slow permeability. Available water capacity is low.

Typical pedon of Drummond silt loam, in an area of Mason-Drummond complex, 0 to 1 percent slopes, 1,000 feet west and 600 feet south of the northeast corner, sec. 20, T. 25 N., R. 10 E.:

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; common fine faint yellowish brown (10YR 5/6) mottles; weak fine platy structure; hard, very friable; slightly acid; abrupt smooth boundary.

B21t—5 to 17 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; weak medium columnar structure parting to moderate medium blocky; extremely hard, very firm; nearly continuous clay films on faces of peds; black stains on faces of peds; neutral; clear smooth boundary.

B22t—17 to 31 inches; very dark grayish brown (10YR 3/2) silty clay, dark grayish brown (10YR 4/2) dry; moderate medium blocky structure; extremely hard, very firm; nearly continuous clay films on faces of peds; soluble salts in fine soft masses and threadlike forms; mildly alkaline; gradual smooth boundary.

B23t—31 to 43 inches; dark grayish brown (10YR 4/2) silty clay, brown (10YR 5/2) dry; weak medium blocky structure; extremely hard, very firm; nearly continuous clay films on faces of peds; few fine black concretions; moderately alkaline; gradual smooth boundary.

B31—43 to 67 inches; dark brown (10YR 4/3) silty clay, brown (10YR 5/3) dry; weak medium blocky structure; extremely hard, very firm; nearly continuous clay films on faces of peds; common fine black concretions; moderately alkaline; gradual smooth boundary.

B32—67 to 80 inches; dark brown (10YR 4/3) silty clay, brown (10YR 5/3) dry; few fine faint yellowish brown (10YR 5/8) mottles; weak medium blocky structure; extremely hard, very firm; nearly continuous clay films on faces of peds; many fine black concretions; about 2 percent lime coated sandstone gravel less than 3 inches in diameter; moderately alkaline; calcareous in places.

The solum is 50 to more than 60 inches thick. The depth to bedrock is more than 72 inches. Depth to the water table ranges from 2 to 6 feet.

The A1 or Ap horizon is very dark grayish brown, very dark gray, dark gray, or dark grayish brown. Some pedons have mottles in shades of brown or yellow. Reaction ranges from slightly acid through mildly alkaline. Some pedons have a thin, lighter colored A2 horizon similar in texture and reaction to the A1 horizon.

The B21t horizon is very dark gray, black, very dark brown, very dark grayish brown, or dark grayish brown. Some pedons are mottled in shades of red or brown. The texture is silty clay loam or silty clay. Reaction ranges from neutral through moderately alkaline. The peds are often coated with black stains or grayish coating in many places. Some pedons have soft masses of lime and lime concretions. Exchangeable sodium content is more than 15 percent.

The B22 horizon is very dark grayish brown, dark grayish brown, brown, or dark brown. Some pedons are mottled in shades of red or brown. Reaction ranges from mildly alkaline through moderately alkaline. There are fine black concretions in places. Soft masses of lime and lime concretions are present in some pedons. Soluble salts are in soft masses and threadlike forms.

The B23t and B3 horizons are dark grayish brown, brown, dark brown, or reddish brown. Some pedons are mottled in shades of red or brown. The texture is silty clay loam or silty clay. Reaction ranges from moderately alkaline through strongly alkaline. Some pedons have lime in soft masses, concretions, and disseminated, threadlike forms.

The C horizon is below a depth of 60 inches in some pedons. Where present it is commonly coarsely mottled in shades of red, brown, or gray. Textures and reactions are similar to those in the B3 horizon.

In this county Drummond soils are mapped only in complex with Mason soils.

Drummond soils are on concave flood plains and are associated on the same landscape with Mason and Osage soils. Mason and Osage soils have less exchangeable sodium content in the upper part of the argillic horizon than that of the Drummond soils.

These soils are taxadjuncts to the Drummond series because the surface layer is not so dark as the surface layer of the Drummond series.

Dwight Series

The Dwight series consists of deep, nearly level through very gently sloping soils on uplands. These soils formed in material weathered from limestone under a cover of grasses.

The Dwight soils are moderately well drained and have very slow permeability. Available water capacity is low.

Typical pedon of Dwight silt loam, in an area of Apperson-Dwight complex, 0 to 3 percent slopes, 900 feet south and 500 feet east of the northwest corner, sec. 28, T. 29 N., R. 7 E.:

A1—0 to 5 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine platy structure parting to weak fine granular; hard, friable; medium acid; abrupt smooth boundary.

B21t—5 to 12 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate medium prismatic structure parting to moderate medium blocky; extremely hard, very firm; nearly continuous clay films on faces of peds; organic stains on faces of peds; medium acid; gradual smooth boundary.

B22t—12 to 26 inches; very dark grayish brown (10YR 3/2) silty clay, dark grayish brown (10YR 4/2) dry; moderate medium blocky structure; extremely hard, very firm; nearly continuous clay films on faces of peds; few fine soft masses of soluble salts; moderately alkaline; gradual smooth boundary.

B3—26 to 50 inches; olive brown (2.5Y 4/4) silty clay, light olive brown (2.5Y 5/4) dry; few fine distinct yellowish brown mottles; weak coarse blocky structure; extremely hard, very firm; patchy clay films on faces of peds; few calcium carbonate concretions; few fine black concretions; few chert pebbles; moderately alkaline; clear irregular boundary.

R—50 to 60 inches; grayish limestone bedrock; partly weathered in upper inch.

These soils are 40 to 60 inches thick over limestone bedrock. Depth to the water table is more than 6 feet.

The A1 or Ap horizon is black, very dark brown, very dark gray, or very dark grayish brown. Brownish or yellowish mottles are in some pedons. Reaction ranges from medium acid through slightly acid except in limed areas.

The B21t horizon is black, very dark gray, very dark brown, dark brown, or very dark grayish brown. Black stains are on faces of peds in many pedons. Grayish coatings are on tops of prisms or faces of peds in some pedons. Mottles are in shades of brown, yellow, or red in most pedons. Reaction ranges from medium acid through mildly alkaline.

The B22t horizon is reddish brown, dark reddish brown, dark brown, very dark grayish brown, dark grayish brown, dark yellowish brown, or olive brown. Mottles are in shades of gray, brown, yellow, or red in most pedons. Soluble salts and lime concretions are in the lower part of this horizon in some pedons. Reaction ranges from neutral through moderately alkaline. Chert or limestone fragments less than 3 inches in diameter make up from 0 to 10 percent, by volume, of this horizon.

The B3 or C horizon is similar in color to the B22t horizon. The texture is silty clay or silty clay loam. Coarse fragments make up from 0 to 20 percent, by volume, of this horizon. Reaction ranges from mildly alkaline through moderately alkaline.

In this county Dwight soils are mapped only in complex with Apperson and Wolco soils.

Dwight soils are in concave depressions and are associated on the same landscape with Apperson and Wolco soils. They have less exchangeable sodium content in the upper part of the argillic horizon than the Dwight soils.

These soils are taxadjuncts to the Dwight series. Soil temperatures are slightly warmer (about 2 to 3 degrees F) than allowed in the range for the Dwight series.

Eufaula Series

The Eufaula series consists of deep, nearly level through moderately steep soils on uplands. These soils formed in sandy sediments under a cover of trees with an understory of grasses.

The Eufaula soils are somewhat excessively drained and have rapid permeability. Available water capacity is low.

Typical pedon of Eufaula loamy fine sand, 3 to 15 percent slopes, 920 feet west and 40 feet north of the southeast corner, sec. 31, T. 23 N., R. 7 E.:

A1—0 to 5 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak medium granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

A21—5 to 48 inches, light yellowish brown (10YR 6/4) fine sand, very pale brown (10YR 7/4) dry; single grained; loose; neutral; clear wavy boundary.

A22&B2t—48 to 72 inches; pink (7.5YR 7/4) fine sand, pink (7.5YR 8/4) dry (A22); single grained; loose; lamellae of yellowish red (5YR 5/6) loamy fine sand, reddish yellow (5YR 6/6) dry (B2t); the lamellae are massive; hard, very friable; wavy and from 1/8 to 1/2 inch thick and from 2 to 6 inches apart; the lamellae have clay bridges between the sand grains; slightly acid.

These soils are more than 60 inches thick to bedrock and have an A horizon 40 inches or more in thickness. Depth to the water table is more than 6 feet.

The A1 or Ap horizon is very dark brown, very dark grayish brown, dark grayish brown, or brown. Reaction ranges from medium acid through slightly acid except in limed areas.

The A21 horizon is brown, pale brown, or light yellowish brown loamy fine sand or fine sand. Reaction ranges from medium acid through neutral.

The A22 horizon is brown, light brown, or pink loamy fine sand or fine sand. Reaction ranges from strongly acid through neutral.

The B2t horizon is yellowish red or strong brown loamy fine sand with thin lamellae of fine sandy loam. Reaction ranges from strongly acid through slightly acid. Some pedons have a continuous B2t horizon rather than lamellae. Where present, lamellae vary from 1/8 to 1 inch thick and from 2 to 10 inches apart and are discontinuous in some profiles.

Eufaula soils are on crests and side slopes and are associated on the same landscape with Dougherty soils. Dougherty soils have loamy argillic horizons, and Eufaula soils have sandy argillic horizons.

Foraker Series

The Foraker series consists of moderately deep, moderately steep through steep soils on uplands. These soils formed in material weathered from shales and thin layers of limestone under a cover of grasses.

The Foraker soils are moderately well drained and have slow permeability. Available water capacity is medium.

Typical pedon of Foraker silty clay loam in an area of Foraker-Shidler complex, 12 to 25 percent slopes, 2,200 feet west and 1,000 feet south of the northeast corner, sec. 16, T. 29 N., R. 7 E.:

A1—0 to 8 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; strong medium granular structure; hard, friable; about 15 percent, by volume, limestone fragments that range from 2 millimeters to 6 inches in diameter and about 3 percent that range from 6 to 15 inches in diameter; calcareous, moderately alkaline; clear smooth boundary.

B1—8 to 11 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium blocky structure parting to moderate medium granular; very hard, very firm; about 15 percent limestone fragments that range from 2 millimeters to 3 inches in diameter; calcareous, moderately alkaline; clear smooth boundary.

B2t—11 to 26 inches; dark gray (5Y 4/1) silty clay, gray (5Y 5/1) dry; few fine distinct yellowish brown mottles; moderate medium blocky structure; very hard, very firm; nearly continuous clay films on faces of peds; few nonintersecting slickensides; few laminated shale fragments less than 3 inches in diameter; common fine lime concretions; films of lime on ped faces; calcareous, moderately alkaline; gradual wavy boundary.

B3—26 to 38 inches; olive gray (5Y 5/2) shaly silty clay, light olive gray (5Y 6/2) dry; common fine and medium distinct yellowish brown (10YR 5/8) mottles; weak medium blocky structure; very hard, very firm; nearly continuous clay films on faces of peds; about 30 percent of horizon is laminated shale fragments less than 3 inches in diameter; common fine lime concretions; few films of lime on faces of peds; calcareous, moderately alkaline; gradual wavy boundary.

Cr—38 to 48 inches; gray (5Y 5/1), olive gray (5Y 5/2), and yellowish brown (10YR 5/8) laminated shale bedrock; calcareous, moderately alkaline.

These soils are 20 to 40 inches thick over shale bedrock. They tend to crack when dry. Depth to the water table is 0.5 to 2 feet.

The A1 horizon is black, very dark brown, very dark gray, or very dark grayish brown. Reaction ranges from mildly alkaline. Coarse fragments less than 3 inches in diameter make up from 0 to 25 percent, by volume, of this horizon and fragments 3 to 15 inches in diameter make up 0 to 15 percent, by volume. Less than 5 percent of the horizon is fragments larger than 15 inches in diameter.

The B1 horizon is very dark gray, very dark grayish brown, or dark grayish brown silty clay loam. The content of coarse fragments is similar to that of the A1 horizon.

The B2t horizon is very dark gray, dark grayish brown, very dark grayish brown, olive brown, light olive brown, or dark gray. In most profiles this horizon is mottled in shades of brown or yellow. The texture is silty clay loam or silty clay. Coarse fragments are mostly less than 3 inches in diameter and occupy from 0 to 20 percent, by volume, of the horizon.

The B3 or C1 horizon, where present, is light olive brown, olive gray, or olive. Mottles or streaks in shades of gray, brown, or yellow are in many pedons. The texture and reaction are similar to those of the B2t

horizon. Shale fragments less than 3 inches in diameter make up from 0 to 50 percent of the volume.

The Cr horizon is shales in shades of gray or olive streaked with shades of yellow, brown, or black. The shales are interbedded in many places with lenses of limestone or sandstone.

Foraker soils are on side slopes and are associated on the same landscape with Apperson, Grainola, Shidler, and Summit soils. Apperson and Summit soils have a thicker solum than that of Foraker soils. Grainola soils do not have the mollic epipedons and Shidler soils do not have the argillic horizons that are present in Foraker soils.

Gasil Series

The Gasil series consists of deep, gently sloping soils on uplands. These soils formed in materials weathered from sandstone and loamy sediments under a cover of trees with an understory of grasses.

The Gasil soils are well drained and have moderate permeability. Available water capacity is medium.

Typical pedon of Gasil fine sandy loam, 3 to 5 percent slopes, 1,880 feet north and 1,400 feet east of the southwest corner of sec. 30, T. 26 N., R. 11 E.:

A1—0 to 8 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak fine granular structure; slightly hard, very friable; medium acid; clear smooth boundary.

A2—8 to 14 inches; brown (10YR 5/3) fine sandy loam, pale brown (10YR 6/3) dry; weak fine granular structure; slightly hard, very friable; medium acid; clear smooth boundary.

B21t—14 to 29 inches; brown (7.5YR 4/4) sandy clay loam, brown (7.5YR 5/4) dry; weak medium subangular blocky structure; hard, friable; patchy clay films on faces of peds; few fine black concretions; strongly acid; gradual smooth boundary.

B22t—29 to 41 inches; strong brown (7.5YR 5/6) sandy clay loam, reddish yellow (7.5YR 6/6) dry; common fine distinct yellowish red mottles; weak medium subangular blocky structure; hard, friable; patchy clay films on faces of peds; few fine black concretions; strongly acid; gradual smooth boundary.

B23t—41 to 51 inches; yellowish brown (10YR 5/4) sandy clay loam, light yellowish brown (10YR 6/4) dry; many fine distinct yellowish red mottles and many coarse distinct light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; very hard, friable; patchy clay films on faces of peds; few medium black concretions; strongly acid; gradual smooth boundary.

B3—51 to 74 inches; coarsely mottled light brownish gray (10YR 6/2) and strong brown (7.5YR 5/6) sandy clay loam, light gray (10YR 7/2) dry and reddish yellow (7.5YR 6/6) dry; weak coarse subangular blocky structure; very hard, friable; patchy clay films on faces of peds; few fine black concretions; strongly acid.

The thickness to bedrock is more than 60 inches. Depth to the water table ranges from 4 to 5 feet.

The A1 or Ap horizon is very dark grayish brown, dark brown, or very dark brown. Reaction ranges from medium acid through slightly acid except in limed areas.

The A2 horizon is grayish brown, brown, or dark grayish brown. Reaction ranges from medium acid through slightly acid except in limed areas.

The B2t horizon is brown, strong brown, yellowish brown, or dark yellowish brown. Mottles are in shades of gray, brown, yellow, or red, but gray mottles are not within 30 inches of the surface. Reaction ranges from strongly acid through medium acid.

The B3 or C horizons are similar in color, texture, and reaction to the B2t horizon, but normally are more mottled with increasing depth. A C horizon is at a depth of 60 to 80 inches in most pedons.

Gasil soils are on side slopes and are associated on the same landscape with Stephenville, Dougherty, and Konawa soils. Stephenville soils have a thinner solum and Dougherty soils have a thicker A horizon than that of Gasil soils. Konawa soils have more reddish colors throughout the argillic horizons than those of Gasil soils.

Grainola Series

The Grainola series consists of moderately deep, moderately steep through steep soils on uplands. These soils formed in material weathered from shales and thin layers of limestone under a cover of grasses.

The Grainola soils are well drained and have slow permeability. Available water capacity is medium.

Typical pedon of Grainola silty clay loam in an area of Grainola-Shidler complex, 12 to 25 percent slopes, 1,060 feet east and 280 feet south of the northwest corner, sec. 14, T. 27 N., R. 5 E.:

A1—0 to 8 inches; dark reddish brown (5YR 3/3) silty clay loam, reddish brown (5YR 4/3) dry; strong medium granular structure; hard, friable; about 30 percent, by volume, limestone fragments less than 3 inches in diameter and about 10 percent, by volume, from 3 to 15 inches in diameter; common lime concretions; calcareous, moderately alkaline; clear smooth boundary.

B1—8 to 13 inches; reddish brown (5YR 4/3) silty clay loam, reddish brown (5YR 5/3) dry; moderate medium granular structure; hard, firm; about 12 percent, by volume, limestone fragments less than 3 inches in diameter; few lime concretions; calcareous, moderately alkaline; gradual smooth boundary.

B2t—13 to 28 inches; dark reddish brown (2.5YR 3/4) silty clay, reddish brown (2.5YR 4/4) dry; common fine light olive gray splotches from weathered shale; weak medium blocky structure; very hard, very firm; nearly continuous clay films on faces of peds; about 5 percent, by volume, sandstone fragments less than 3 inches in diameter; few lime concretions; few soft masses of lime; calcareous, moderately alkaline; clear wavy boundary.

B3—28 to 36 inches; dark reddish brown (2.5YR 3/4) silty clay, reddish brown (2.5YR 4/4) dry; weak medium blocky structure; very hard, very firm; patchy clay films on faces of peds; about 40 percent, by volume, of dark reddish brown and light olive gray shale fragments less than 3 inches in diameter; few lime concretions; common soft masses of lime; calcareous, moderately alkaline; clear wavy boundary.

Cr—36 to 42 inches; weak red (2.5YR 4/2) laminated shale bedrock; coatings of lime on surfaces of some fragments; calcareous, moderately alkaline.

These soils are 20 to 40 inches thick over shale bedrock. Depth to the water table is more than 6 feet. Grainola soils crack when dry.

The A1 horizon is dark reddish brown, dark reddish gray, or dark brown. Coarse fragments of limestone or sandstone less than 3 inches in diameter make up from 5 to 35 percent of the volume and coarse fragments 3 to 15 inches in diameter make up from 0 to 20 percent, by volume.

The B1 horizon is dark reddish brown, dark reddish gray, or reddish brown silty clay loam or silty clay. The content of coarse fragments is similar to that of the A1 horizon.

The B2t and B3 horizon colors are dark reddish or reddish brown. They are commonly streaked or coarsely mottled with light brownish gray, light olive gray, or pale olive. These colors resemble the mixed color of the parent materials. Texture is silty clay loam or silty clay. Coarse fragments of shale less than 3 inches in diameter make up from 0 to 15 percent, by volume, of the B2t horizon and from 5 to 45 percent of the B3 horizon.

The Cr horizon is mainly reddish laminated siltstone or shale that is streaked or mottled in many places with grayish or olive colors. Thin strata of sandstone or limestone are interbedded in some profiles.

Grainola soils are on side slopes and are associated on the same landscape with Corbin, Foraker, and Shidler soils. Corbin soils have a thicker solum than that of Grainola soils. Foraker soils have darker A horizon colors than that of Grainola soils. Shidler soils do not have the argillic horizons that are present in Grainola soils.

Kiomatia Series

The Kiomatia series consists of deep, nearly level through very gently sloping soils on flood plains. These soils formed in sandy sediments under a cover of trees with an understory of grasses. They are subject to flooding.

The Kiomatia soils are well drained and have rapid permeability. Available water capacity is low.

Typical pedon of Kiomatia loamy fine sand in an area of Kiomatia soils, 1,200 feet west and 150 feet south of the northeast corner, sec. 32, T. 24 N., R. 3 E.:

A1—0 to 16 inches; dark grayish brown (10YR 4/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak medium granular structure; soft, very friable; mildly alkaline; clear wavy boundary.

C1—16 to 30 inches; brown (7.5YR 5/4) loamy fine sand, light brown (7.5YR 6/4) dry; thin dark grayish brown (10YR 4/2) strata; single grained; loose; moderately alkaline; clear wavy boundary.

C2—30 to 60 inches; light brown (7.5YR 6/4) fine sand, pink (7.5YR 7/4) dry; single grained; loose; thin bands of coarse sand and very fine sand; slightly acid.

These soils are more than 60 inches deep to bedrock. Reaction ranges from slightly acid through moderately alkaline. Depth to the water table ranges from 4 to 10 feet.

The A1 or Ap horizon is dark brown, dark grayish brown, or brown loamy fine sand, fine sandy loam, very fine sandy loam, or clay loam. In places, lighter colored sediments have been recently deposited over the A1 horizon.

The C horizon is reddish brown, brown, light brown, or pale brown. Most pedons have thin strata of darker or lighter colored material. This horizon is stratified, in many places, with thin bands of loamy or clayey soil materials.

Kiomatia soils are on convex flood plains and are associated on the same landscape with Choska and Pursley Variant soils. Choska soils have a coarse silty control section; Pursley Variant soils have a fine loamy over sandy or sandy skeletal control section; and Kiomatia soils have a sandy control section.

The Kiomatia soils are taxadjuncts to the series. The A horizon has colors in hue of 10YR and is slightly thicker than is allowed in the range for the Kiomatia series.

Konawa Series

The Konawa series consists of deep, gently sloping through sloping soils on uplands. These soils formed in material weathered from limestone and thin layers of chert under a cover of trees with an understory of grasses.

The Konawa soils are well drained and have moderate permeability. Available water capacity is medium.

Typical pedon of Konawa loamy fine sand, 3 to 8 percent slopes, eroded, 2,200 feet north and 1,380 feet west of the southeast corner, sec. 22, T. 20 N., R. 10 E.:

Ap—0 to 6 inches; brown (10YR 4/3) loamy fine sand, brown (10YR 5/3) dry; weak fine granular structure; slightly hard, very friable; soil reaction higher than normal because of dust from road; slightly acid; clear smooth boundary.

A2—6 to 15 inches; brown (10YR 5/3) loamy fine sand, very pale brown (10YR 7/3) dry; weak fine granular structure; soft; soil reaction higher than normal because of dust from road; slightly acid; clear smooth boundary.

B2t—15 to 30 inches; reddish brown (5YR 4/4) sandy clay loam, reddish brown (5YR 5/4) dry; moderate medium subangular blocky structure; very hard, friable; nearly continuous clay films on faces of peds; slightly acid; gradual smooth boundary.

B3—30 to 43 inches; yellowish red (5YR 4/6) sandy clay loam, yellowish red (5YR 5/6) dry; weak medium subangular blocky structure; very hard, friable; patchy clay films on faces of peds; slightly acid; gradual smooth boundary.

C—43 to 62 inches; yellowish red (5YR 5/6) loamy fine sand, reddish yellow (5YR 6/6) dry; massive; slightly hard, very friable; slightly acid.

These soils have an A horizon less than 20 inches thick. Solum thickness ranges from 48 to more than 72 inches. Depth to bedrock is more than 60 inches. Depth to the water table is more than 6 feet.

The Ap or A1 horizon is very dark grayish brown, dark grayish brown, brown, or dark brown. Reaction ranges from medium acid through slightly acid except in limed areas.

The A2 horizon is brown, dark brown, light brown, pale brown, light yellowish brown, or yellowish brown loamy fine sand or fine sand. Reaction ranges from medium acid through slightly acid.

The B2 horizon is reddish brown or yellowish red. Reaction ranges from medium acid through slightly acid.

The B3 horizon is reddish brown or yellowish red sandy clay loam or fine sandy loam. Reaction ranges from medium acid through slightly acid.

The C horizon is similar in color and reaction to the B3 horizon. The texture is loamy fine sand or fine sandy loam.

Konawa soils are on side slopes and are associated on the same landscape with Dougherty and Gasil soils. Dougherty soils have a thicker A horizon than that of the Konawa soils, and the Gasil soils have a more yellow argillic horizon than the one in Konawa soils.

These soils are taxadjuncts to the Konawa series. They are slightly acid in the argillic horizon; this is outside the range of the Konawa series.

Lightning Series

The Lightning series consists of deep, nearly level soils on flood plains. These soils formed in clayey sediments under a cover of trees with an understory of grasses. They are subject to flooding.

The Lightning soils are somewhat poorly drained and have very slow permeability. Available water capacity is medium.

Typical pedon of Lightning silt loam, 1,240 feet west and 300 feet south of the northeast corner, sec. 29, T. 22 N., R. 11 E.:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; few fine distinct strong brown mottles; weak medium platy structure parting to weak fine granular; hard, friable; slightly acid; clear smooth boundary.

A2—7 to 10 inches; dark grayish brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) dry; common fine distinct strong brown mottles; weak fine granular structure; very hard, firm; medium acid; clear smooth boundary.

B21tg—10 to 24 inches; dark grayish brown (10YR 4/2) silty clay loam, grayish brown (10YR 5/2) dry; few fine distinct strong brown mottles and common medium distinct dark brown (7.5YR 4/4) mottles; weak medium blocky structure; extremely hard, very firm; patchy clay films on faces of peds; grayish coatings on faces of some peds; few fine black concretions; medium acid; gradual wavy boundary.

B22tg—24 to 37 inches; dark grayish brown (10YR 4/2) silty clay loam, grayish brown (10YR 5/2) dry; common medium distinct strong brown (7.5YR 5/8) mottles; weak medium blocky structure; extremely hard, very firm; patchy clay films on faces of peds; grayish coatings on faces of some peds; few fine black concretions; slightly acid; gradual wavy boundary.

B23t—37 to 57 inches; dark grayish brown (10YR 4/2) silty clay, grayish brown (10YR 5/2) dry; many fine and medium distinct strong brown (7.5YR 5/8) mottles; weak medium blocky structure; extremely hard, very firm; nearly continuous clay films on faces of peds; common fine black concretions; neutral; gradual wavy boundary.

B3—57 to 72 inches; dark brown (7.5YR 4/4) silty clay, brown (7.5YR 5/4) dry; common coarse distinct grayish brown (10YR 5/2) mottles and common medium distinct strong brown (7.5YR 5/8) mottles; weak coarse blocky structure; extremely hard, very firm; patchy clay films on faces of peds; few fine black concretions; mildly alkaline.

Solum thickness and depth to bedrock is more than 60 inches. Depth to the water table ranges from 0 to 1 foot.

The Ap or A1 horizon is very dark gray, dark gray, very dark grayish brown, or dark grayish brown. Reaction ranges from medium acid through slightly acid except in limed areas.

The A2 horizon is dark gray, gray, dark grayish brown, grayish brown, or light brownish gray. It has brownish, yellowish, or reddish mottles in most places. The texture is silt loam or silty clay loam. Reaction ranges from medium acid through neutral.

The B2tg horizon is very dark brown, very dark grayish brown, dark grayish brown, or brown mottled in shades of gray, brown, yellow, or red. Most pedons have grayish or black coatings on the faces of peds in the upper part of the B2t horizon. The texture is silty clay loam or silty clay. Slickensides are present in some pedons. Reaction ranges from medium acid through neutral.

The B3 horizon is similar to the B2t horizon in color and texture except that mottles are coarser and more abundant. Reaction ranges from neutral through moderately alkaline.

Lightning soils are on concave flood plains and are associated on the same landscape with Mason and Osage soils. Mason soils have a less clayey control section than Lightning soils. Osage soils do not have the argillic horizons that are present in Lightning soils.

These soils are taxadjuncts to the Lightning series. They have chroma of 2 in the argillic horizon; this is outside the range of the Lightning series.

Lucien Series

The Lucien series consists of shallow, gently sloping through strongly sloping soils on uplands. These soils formed in material weathered from sandstone under a cover of grasses.

The Lucien soils are well drained and have moderately rapid permeability. Available water capacity is low.

Typical pedon of Lucien fine sandy loam, in an area of Stoneburg-Lucien complex, 3 to 12 percent slopes, 2,420 feet west and 1,050 feet south of the northeast corner, sec. 12, T. 27 N., R. 5 E.:

A1—0 to 7 inches; dark brown (7.5YR 3/2) fine sandy loam, brown to dark brown (7.5YR 4/2) dry; weak fine granular structure; hard, very friable; medium acid; clear wavy boundary.

B2—7 to 18 inches; dark brown (7.5YR 3/2) fine sandy loam, brown (7.5YR 4/2) dry; 15 percent reddish brown (5YR 4/4) sandstone fragments less than 3 inches in diameter; weak fine granular structure; hard, very friable; medium acid; abrupt irregular boundary.

Cr—18 to 20 inches; soft, reddish brown, acid sandstone bedrock.

These soils are 10 to 20 inches thick over sandstone bedrock. Depth to the water table is more than 6 feet.

The A1 horizon is dark brown or reddish brown. Reaction ranges from medium acid through slightly acid. The soil has 0 to 20 percent, by volume, sandstone fragments 3 to 12 inches in diameter and from 0 to 5 percent, by volume, sandstone fragments less than 3 inches in diameter.

The B2 horizon is dark brown, dark reddish brown, or reddish brown fine sandy loam or very fine sandy loam. Reaction ranges from medium acid through slightly acid. The horizon has from 0 to 5 percent, by volume, sandstone fragments 3 to 12 inches in diameter and from 0 to 10 percent, by volume, sandstone fragments less than 3 inches in diameter.

The Cr horizon is dark reddish brown, reddish brown, yellowish red, or reddish yellow. In some pedons, the sandstone is interbedded with lenses of reddish, brownish, or grayish alkaline shales.

In this county Lucien soils are mapped only in complex with Stoneburg soils.

Lucien soils are on crests and upper slopes and are associated on the same landscape with Corbin and Stoneburg soils. Corbin and Stoneburg soils have an argillic horizon, and Lucien soils do not.

Lula Series

The Lula series consists of deep, very gently sloping soils on uplands. These soils formed in material weathered from limestone under a cover of grasses.

The Lula soils are well drained and have moderate permeability. Available water capacity is high.

Typical profile of Lula silt loam, 1 to 3 percent slopes, 90 feet west and 240 feet north of the center of sec. 36, T. 26 N., R. 8 E.:

A1—0 to 10 inches; dark brown (7.5YR 3/2) silt loam, brown to dark brown (7.5YR 4/2) dry; moderate medium granular structure; slightly hard, very friable; slightly acid; gradual smooth boundary.

B1—10 to 18 inches; dark reddish brown (5YR 3/3) silty clay loam, reddish brown (5YR 4/3) dry; strong medium granular structure; hard, friable; slightly acid; gradual smooth boundary.

B21t—18 to 34 inches; reddish brown (5YR 4/4) silty clay loam, reddish brown (5YR 5/4) dry; weak medium subangular blocky structure parting to moderate medium granular; very hard, friable; nearly continuous clay films on faces of peds; slightly acid; gradual smooth boundary.

B22t—34 to 49 inches; reddish brown (5YR 4/4) silty clay loam, reddish brown (5YR 5/4) dry; moderate medium blocky structure parting to strong medium granular; very hard, firm; nearly continuous clay films on faces of peds; few fine black concretions; neutral; abrupt irregular boundary.

R—49 to 50 inches; hard, coarsely fractured limestone bedrock.

These soils are 40 to 60 inches thick over hard limestone bedrock. Depth to the water table is more than 6 feet.

The A1 or Ap horizon is very dark brown, dark brown, or very dark grayish brown. Reaction ranges from medium acid through slightly acid except in limed areas.

The B1 horizon is dark reddish brown or dark brown silt loam or silty clay loam. Reaction ranges from medium acid through slightly acid.

The B2t horizon is dark reddish brown or reddish brown. Reaction ranges from medium acid through neutral.

Some pedons have a B3 horizon that is similar to the B2t horizon in color and texture. Reaction ranges from slightly acid through mildly alkaline.

The lower part of the B2t or the B3 horizon of some pedons has from 0 to 10 percent, by volume, chert or limestone fragments less than 3 inches in diameter and from 0 to 20 percent, by volume, fragments larger than 3 inches in diameter.

Lula soils are on crests, side slopes, and valleys and are associated on the same landscape with Apperson and Catoosa soils. Apperson soils have a more clayey control section than Lula soils. Catoosa soils have a thinner solum than Lula soils.

Mason Series

The Mason series consists of deep, nearly level through very gently sloping soils on flood plains. These soils formed in loamy sediments under a cover of trees with an understory of grasses.

The Mason soils are well drained to moderately well drained and have moderately slow permeability. Available water capacity is high.

Typical pedon of Mason silt loam, 0 to 1 percent slopes, 1,440 feet east and 1,050 feet south of the northwest corner sec. 13, T. 26 N., R. 9 E.:

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak medium platy structure parting to weak medium granular; slightly hard, very friable; medium acid; clear smooth boundary.

A1—6 to 13 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine and medium structure; slightly hard, very friable; slightly acid; gradual smooth boundary.

B1—13 to 21 inches; dark brown (10YR 3/3) silty clay loam, brown to dark brown (10YR 4/3) dry; weak medium granular subangular blocky structure parting to moderate medium granular; hard, friable; patchy clay films on faces of peds; slightly acid; gradual smooth boundary.

B21t—21 to 30 inches; brown (10YR 4/3) silty clay loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; very hard, friable; nearly continuous clay films on faces of peds; medium acid; gradual smooth boundary.

B22t—30 to 47 inches; brown (10YR 4/3) silty clay loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; very hard, friable; nearly continuous clay films on faces of peds; slightly acid; gradual smooth boundary.

B23t—47 to 57 inches; brown (10YR 4/3) silty clay loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; very hard, friable; nearly continuous clay films on faces of peds; few fine black concretions; slightly acid; gradual smooth boundary.

B31—57 to 71 inches; brown (10YR 5/3) silty clay loam, pale brown (10YR 6/3) dry; few medium faint strong brown (7.5YR 5/6) mottles; weak coarse subangular blocky structure; very hard, friable; patchy clay films on faces of peds; few fine black concretions; slightly acid; gradual smooth boundary.

B32—71 to 96 inches; brown (10YR 5/3) silty clay loam, pale brown (10YR 6/3) dry; many coarse distinct strong brown (7.5YR 5/6) mottles and few medium distinct grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; very hard, friable; patchy clay films on faces of peds; common fine black concretions; slightly acid.

These soils are more than 60 inches thick to bedrock. Depth to the water table is more than 6 feet.

The A1 or Ap horizon is very dark brown or very dark grayish brown. Reaction ranges from medium acid through slightly acid except in limed areas.

The B1 horizon is very dark brown, very dark grayish brown, or dark brown silt loam or silty clay loam. Reaction ranges from medium acid through slightly acid.

The B2t horizon is very dark grayish brown, dark brown, brown, or dark grayish brown. Reaction ranges from medium acid through slightly acid. The lower part of the B2t horizon has brownish or yellowish mottles in some pedons.

The B3 or C horizon is dark brown, brown, or yellowish brown with mottles in shades of gray, brown, yellow, or red in most pedons. The texture is loam or silty clay loam. Reaction ranges from medium acid through slightly acid in the B3 horizon and from medium acid through mildly alkaline in the C horizon.

Mason soils are on convex flood plains and are associated on the same landscape with Barnsdall, Drummond, Lightning, Osage, and Verdigris soils. Barnsdall soils have a lighter colored A horizon than the one in Mason soils. Drummond soils have more exchangeable sodium content in the upper part of the argillic horizon than that of Mason soils. Lightning and Osage soils have a more clayey control section than Mason soils. Verdigris soils do not have the argillic horizon that is present in Mason soils.

Minco Series

The Minco series consists of deep, sloping soils on uplands. These soils formed in loamy sediments under a cover of grasses.

The Minco soils are well drained and have moderate permeability. Available water capacity is high.

Typical pedon of Minco silt loam, 5 to 8 percent slopes, 2,000 feet north and 50 feet west of the southeast corner, sec. 34, T. 24 N., R. 4 E.:

Ap—0 to 10 inches; dark brown (7.5YR 3/2) silt loam, brown (7.5YR 5/2) dry; weak medium granular structure; slightly hard, very friable; medium acid; clear smooth boundary.

A1—10 to 19 inches; dark brown (7.5YR 3/3) silt loam, brown to dark brown (7.5YR 4/3) dry; weak medium granular structure; hard, friable; many worm casts; slightly acid; gradual smooth boundary.

B2—19 to 38 inches; reddish brown (5YR 4/4) silt loam, reddish brown (5YR 5/4) dry; weak medium subangular blocky structure parting to weak medium granular; hard, friable; few worm casts; neutral; gradual smooth boundary.

C—38 to 62 inches; yellowish red (5YR 4/6) silt loam, yellowish red (5YR 5/6) dry; massive; hard, friable; neutral.

These soils are more than 60 inches thick to bedrock. Depth to the water table is more than 6 feet.

The Ap or A1 horizon is dark brown or very dark grayish brown. Reaction ranges from medium acid through slightly acid except in limed areas.

The B2 horizon is brown or reddish brown silt loam or very fine sandy loam. Reaction ranges from slightly acid through neutral.

The C horizon is brown, reddish brown, or yellowish red silt loam or very fine sandy loam. Reaction ranges from slightly acid through neutral.

Minco soils are on side slopes and are associated on the same landscape with Norge and Teller soils. Norge and Teller soils have argillic horizons which are not present in Minco soils.

Niotaze Series

The Niotaze series consists of moderately deep, gently sloping through steep soils on uplands. These soils formed in material weathered from shale interbedded with thin layers of sandstone under a cover of trees with an understory of grasses.

The Niotaze soils are somewhat poorly drained and have slow permeability. Available water capacity is medium.

Typical pedon of Niotaze silt loam, in an area of Niotaze-Darnell complex, 3 to 15 percent slopes, 1,500 feet west and 2,100 feet north of the southeast corner, sec. 27. T. 22 N., R. 11 E.:

A1—0 to 3 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; slightly hard, very friable; about 10 percent by volume sandstone fragments less than 3 inches in diameter, 20 percent by volume sandstone fragments from 3 to 10 inches in diameter, and 10 percent by volume sandstone fragments more than 10 inches in diameter; reaction higher than normal because of road dust; neutral; clear smooth boundary.

A2—3 to 6 inches, brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; weak medium granular structure; slightly hard, very friable; content of coarse fragments similar to horizon above; slightly acid; abrupt smooth boundary.

IIB21t—6 to 15 inches; reddish brown (5YR 4/4) silty clay, reddish brown (5YR 4/4) dry; few fine faint grayish brown mottles; strong medium granular structure; hard, firm; nearly continuous clay films on faces of peds; many peds in upper 3 inches coated with soil material similar to that described in horizon above; about 5 percent by volume sandstone fragments less than 3 inches in diameter; very strongly acid; gradual wavy boundary.

IIB22t—15 to 21 inches; coarsely mottled yellowish red (5YR 4/6), light olive brown (2.5Y 5/4), and red (2.5YR 4/6) silty clay; weak medium subangular blocky structure parting to moderate medium granular; very hard, very firm; nearly continuous clay films on faces of peds; very strongly acid; gradual wavy boundary.

IIB23t—21 to 28 inches; coarsely mottled olive (5Y 5/3), yellowish brown (10YR 5/6), and yellowish red (5YR 4/6) silty clay; weak medium blocky structure; extremely hard, very firm; nearly continuous clay films on faces of peds; very strongly acid; gradual smooth boundary.

IIB3—28 to 36 inches; olive (5Y 5/3) silty clay, pale olive (5Y 6/3) dry; many coarse distinct yellowish brown (10YR 5/8) mottles; weak medium blocky structure; very hard, very firm; patchy clay films on faces of peds; about 45 percent of horizon is siltstone or shale fragments less than 3 inches in diameter; slightly acid; clear smooth boundary.

IICr—36 to 60 inches; olive (5Y 5/3), yellowish brown (10YR 5/8), and dark grayish brown (10YR 4/2) soft, laminated shale bedrock; neutral.

These soils are 20 to 40 inches thick over shale bedrock. Depth to the water table ranges from 1/2 to 1 foot.

The A1 horizon is very dark brown, very dark grayish brown, or dark brown loam, silt loam, very fine sandy loam, or fine sandy loam. As much as 1 inch of organic litter is on the surface in places. Sandstone fragments less than 3 inches in diameter make up from 0 to 60 percent, by volume, of the horizon; sandstone fragments from 3 to 15 inches in diameter make up from 0 to 80 percent; and sandstone fragments more than 15 inches in diameter make up from 0 to 30 percent.

The A2 horizon is dark grayish brown, grayish brown, dark brown, or brown silt loam, loam, very fine sandy loam, or fine sandy loam. Reaction ranges from strongly acid through medium acid. The content of coarse fragments is similar to that of the A1 horizon.

The IIB2t horizon is dark reddish brown, dark red, reddish brown, red, yellowish red, brown, dark brown, yellowish brown, or light olive brown. Reddish or yellowish colors are dominant in the upper part, and brownish colors are dominant in the lower part. Some pedons have mottled matrix colors in shades of olive, red, or brown. Most pedons are mottled in shades of red, yellow, olive, or brown. Reaction ranges from very strongly acid through strongly acid. Sandstone fragments less than 3 inches in diameter make up from 0 to 10 percent, by volume, of the horizon.

The IIB3 horizon is dominantly brownish or yellowish and is coarsely mottled in shades of red, yellow, brown, olive, or gray. Reaction ranges from strongly acid through slightly acid. Shale fragments less than 3 inches in diameter make up from 10 to 85 percent, by volume, of the horizon.

The IICr horizon is shades of gray, brown, yellow, or olive. Reaction ranges from neutral through moderately alkaline.

Niotaze soils are on crests and side slopes and are associated on the same landscape with Darnell and Stephenville soils. Darnell soils do not have argillic horizons, which are present in Niotaze soils. Stephenville soils have a less clayey control section than the Niotaze soils.

Norge Series

The Norge series consists of deep, very gently sloping through sloping soils on uplands. These soils formed in loamy sediments under a cover of grasses.

The Norge soils are well drained and have moderately slow permeability. Available water capacity is high.

Typical pedon of Norge silt loam, 3 to 5 percent slopes, 250 feet north and 250 feet west of the southeast corner, sec. 11, T. 24 N., R. 5 E.:

Ap—0 to 8 inches; dark brown (7.5YR 3/2) silt loam, brown (7.5YR 4/2) dry; moderate medium granular structure; slightly hard, friable; mildly alkaline; this field has been limed; clear smooth boundary.

B1—8 to 13 inches; dark reddish brown (5YR 3/3) silty clay loam, reddish brown (5YR 4/3) dry; weak fine subangular blocky structure parting to moderate medium granular; hard, friable; slightly acid; clear smooth boundary.

B21t—13 to 32 inches; reddish brown (5YR 4/4) silty clay loam, reddish brown (5YR 5/4) dry; weak medium prismatic structure parting to moderate medium granular; very hard, firm; nearly continuous clay films on faces of peds; slightly acid; gradual smooth boundary.

B22t—32 to 48 inches; reddish brown (5YR 4/4) silty clay loam, reddish brown (5YR 5/4) dry; moderate medium subangular blocky structure; very hard, very firm; nearly continuous clay films on faces of peds; neutral; gradual smooth boundary.

B3—48 to 72 inches; yellowish red (5YR 4/6) silty clay loam, yellowish red (5YR 5/6) dry; common medium distinct light reddish brown (5YR 6/3) mottles; weak medium subangular blocky structure; very hard, very firm; patchy clay films on faces of peds; few fine black concretions; neutral.

These soils are more than 60 inches thick to bedrock. Depth to the water table is more than 6 feet.

The Ap or A1 horizon is dark brown, very dark grayish brown, or very dark brown. Reaction ranges from medium acid through slightly acid except in limed areas.

The B1 horizon is dark reddish brown or dark brown clay loam or silty clay loam. Reaction ranges from medium acid through slightly acid.

The B2t horizon is reddish brown or yellowish red. Mottles in shades of red or brown are in the lower part of some profiles. The texture is clay loam or silty clay loam. Reaction ranges from medium acid through neutral.

The B3 horizon is similar to the B2t horizon in color and texture except that in many places it is mottled in shades of red or brown. Reaction ranges from slightly acid through neutral. In some pedons waterworn pebbles less than 3 inches in diameter make up from 0 to 2 percent, by volume, of the B3 horizon.

Norge soils are on crests and side slopes and are associated on the same landscape with Corbin, Minco, Pawhuska, and Vanoss soils. The lower part of the argillic horizon in Corbin soils is more clayey than the Norge soils; Minco soils have a less clayey control section than Norge soils; the upper part of the argillic horizon in Pawhuska soils has more exchangeable sodium content

than the argillic horizon in the Norge soils. The argillic horizon in Vanoss soils has colors in hues 7.5YR and 10YR, but the argillic horizon in Norge soils is more reddish.

Okemah Series

The Okemah series consists of deep, nearly level through very gently sloping soils on uplands. These soils formed in material weathered from shales under a cover of grasses.

The Okemah soils are moderately well drained and have slow permeability. Available water capacity is high.

Typical pedon of Okemah silt loam, 0 to 2 percent slopes, 2,620 feet west and 740 feet north of the southeast corner, sec. 31, T. 26 N., R. 8 E.:

A11—0 to 10 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate medium granular structure; slightly hard, friable; medium acid; gradual smooth boundary.

A12—10 to 15 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; strong medium granular structure; hard, friable; slightly acid; gradual smooth boundary.

B1—15 to 21 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; few fine faint strong brown mottles; weak medium subangular blocky structure parting to strong medium granular structure; hard, firm; patchy clay films on faces of peds; slightly acid; gradual smooth boundary.

B21t—21 to 34 inches; very dark grayish brown (10YR 3/2) silty clay, dark grayish brown (10YR 4/2) dry; common medium and coarse distinct yellowish red (5YR 5/6) mottles and few fine faint dark grayish brown mottles; moderate medium blocky structure; very hard, very firm; nearly continuous clay films on faces of peds; few fine black concretions; slightly acid; gradual smooth boundary.

B22t—34 to 50 inches; very dark grayish brown (10YR 3/2) silty clay, dark grayish brown (10YR 4/2) dry; common coarse distinct strong brown (7.5YR 5/6) mottles, few medium faint very dark gray (10YR 3/1) mottles, and few fine distinct yellowish red mottles; moderate medium blocky structure; extremely hard, very firm; nearly continuous clay films on faces of peds; neutral; gradual smooth boundary.

B3—50 to 71 inches; coarsely mottled dark grayish brown (10YR 4/2), strong brown (7.5YR 5/6), very dark gray (10YR 3/1), and gray (10YR 5/1) silty clay; weak medium blocky structure; extremely hard, very firm; nearly continuous clay films on faces of peds; few fine black concretions; neutral.

These soils are more than 60 inches thick to shales interbedded with thin layers of sandstone. Depth to the water table ranges from 1 to 2 feet.

The A1 or Ap horizon is black, very dark brown, or very dark gray. Reaction ranges from medium acid through slightly acid except in limed areas.

The B1 horizon is similar to the A horizon in color, texture, and reaction except that in many places it has brownish or reddish mottles and has slightly more clay.

The B2t horizon is very dark gray, very dark grayish brown, or dark grayish brown. Mottles are shades of red, brown, yellow, or gray. In many pedons, the lower part of this horizon has coarsely mottled colors. The texture is silty clay loam or silty clay. Reaction ranges from slightly acid through mildly alkaline.

The B3 horizon is commonly coarsely mottled in shades of red, brown, yellow, or gray. Some pedons have dominant matrix colors with mottles similar to those of the B2t horizon. Reaction ranges from neutral through mildly alkaline. Rock fragments less than 3 inches in diameter make up from 0 to 10 percent, by volume of this horizon. Some pedons have calcium carbonate concretions in this horizon.

Okemah soils are on valleys and are associated on the same landscape with Dennis and Parsons soils. Dennis soils have slightly lighter colors in the upper part of the solum than those of the Okemah soils. Parsons soils have an abrupt textural change between the A and B horizon; this change is not present in Okemah soils.

Osage Series

The Osage series consists of deep, nearly level soils on flood plains. These soils formed in clayey sediments under a cover of trees with an understory of grasses. They are subject to flooding.

The Osage soils are poorly drained and have very slow permeability. Available water capacity is medium.

Typical pedon of Osage silty clay, 700 feet south and 50 feet east of the northwest corner, sec. 33, T. 26 N., R. 9 E.:

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate medium granular structure; hard, firm; slightly acid; clear smooth boundary.

A1—8 to 16 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; strong medium granular structure; very hard, very firm; neutral; gradual smooth boundary.

B21g—16 to 29 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; common coarse distinct brown (10YR 4/3) mottles; moderate medium blocky structure; extremely hard, very firm; few slickensides, few fine black concretions; neutral; gradual smooth boundary.

B22g—29 to 38 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; common coarse distinct dark yellowish brown (10YR 4/4) mottles; weak medium blocky structure; extremely hard, very firm; few slickensides; few fine black concretions; neutral; gradual smooth boundary.

B23g—38 to 50 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; many medium distinct dark yellowish brown (10YR 4/4) mottles and few fine distinct very dark gray mottles; weak medium blocky structure; extremely hard, very firm; common fine black concretions; common calcium carbonate concretions; calcareous in spots; mildly alkaline; gradual smooth boundary.

B3—50 to 72 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; many fine and medium yellowish brown (10YR 5/6) mottles and few fine distinct very dark gray mottles; weak medium blocky structure; extremely hard, very firm; common fine black concretions; few calcium carbonate concretions; calcareous in spots; mildly alkaline.

These soils are more than 60 inches thick to bedrock. They shrink and crack when dry and swell when moist. Depth to the water table ranges from 0 to 2 feet.

The A1 or Ap horizon is black, very dark gray, or very dark brown. Faint brownish mottles are in the lower part of the A horizon in some pedons. Reaction ranges from medium acid through neutral except in limed areas.

The upper part of the B horizon is black or very dark gray. Brownish mottles are present in most pedons. Reaction ranges from medium acid through neutral. The lower part of the B horizon is very dark gray, dark gray, very dark grayish brown, or dark grayish brown. Brownish, black, or grayish mottles are in most pedons. Reaction ranges from neutral through moderately alkaline. Calcium carbonate concretions are not in all pedons. Some pedons have soft masses of calcium carbonate or gypsum crystals in the lower part of the B horizons.

The Osage soils are on concave flood plains and are associated on the same landscape with Drummond and Lightning soils. Drummond soils have more exchangeable

sodium content than that of Osage soils. Lightning soils have argillic horizons, which are not present in Osage soils.

Parsons Series

The Parsons series consists of deep, nearly level through very gently sloping soils on uplands. These soils formed in material weathered from shales or clayey sediments under a cover of grasses.

The Parsons soils are somewhat poorly drained and have very slow permeability. Available water capacity is medium.

Typical pedon of Parsons silt loam, 1 to 3 percent slopes, 2,370 feet south and 450 feet west of the northeast corner, sec. 4, T. 21 N., R. 10 E.:

A1—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine and medium granular structure; slightly hard, very friable; medium acid; clear smooth boundary.

A2—9 to 12 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; slightly hard, very friable; medium acid; abrupt smooth boundary.

B21tg—12 to 20 inches; very dark grayish brown (10YR 3/2) silty clay, dark grayish brown (10YR 4/2) dry; common fine distinct yellowish red mottles; moderate medium blocky structure; very hard, very firm; nearly continuous clay films on faces of peds; few fine black concretions; neutral; gradual smooth boundary.

B22tg—20 to 32 inches; dark grayish brown (10YR 4/2) silty clay, grayish brown (10YR 5/2) dry; few medium faint brown (7.5YR 4/4) mottles; weak medium blocky structure; extremely hard, very firm; nearly continuous clay films on faces of peds; few fine black concretions; mildly alkaline; gradual smooth boundary.

B23tg—32 to 40 inches; coarsely mottled dark brown (7.5YR 4/4), very dark gray (10YR 3/1), yellowish brown (10YR 5/8), and light brownish gray (2.5Y 6/2) silty clay; weak medium blocky structure; extremely hard, very firm; nearly continuous clay films on faces of peds; few fine black concretions; moderately alkaline; gradual smooth boundary.

B31—40 to 55 inches; coarsely mottled light gray (10YR 6/1), yellowish brown (10YR 5/8), and brown (7.5YR 4/4) silty clay; weak medium blocky structure; extremely hard, very firm; patchy clay films on faces of peds; few fine black concretions; mildly alkaline; gradual smooth boundary.

B32—55 to 70 inches; coarsely mottled gray (10YR 5/1), very dark gray (10YR 3/1), light gray (10YR 7/1), and brown (7.5YR 4/4) silty clay; weak medium blocky structure; extremely hard, very firm; patchy clay films on faces of peds; few fine black concretions; neutral; clear smooth boundary.

Cr—70 to 76 inches; yellowish brown (10YR 5/8) and gray (10YR 5/1) weakly laminated shale bedrock.

These soils are more than 60 inches thick over shale bedrock. Depth to the water table ranges from 1 to 1 1/2 feet.

The A horizon is less than 16 inches thick and changes abruptly to the B2t horizon. The A1 or Ap horizon is very dark grayish brown or very dark gray. Reaction ranges from medium acid through slightly acid except in limed areas.

The A2 horizon is dark gray, dark grayish brown, or grayish brown. Brownish mottles are in this horizon in some pedons. Reaction ranges from medium acid through slightly acid.

The upper part of the B2t horizon is very dark brown, very dark grayish brown, or dark brown. The lower part of the B2t horizon is very dark grayish brown, dark grayish brown, grayish brown, brown, or olive brown. The B2t horizon is mottled in shades of red, brown, or gray. Reaction ranges from medium acid through neutral in the upper part and from medium acid through moderately alkaline in the lower part.

The B3 and Cr horizon is commonly coarsely mottled in shades of red, brown, or gray. Some pedons have dominant matrix colors of dark grayish brown, yellowish brown, grayish brown, or olive brown with mottles in shades of red, brown, or gray. Coarse fragments less than 3 inches in diameter make up from 0 to 10 percent of the horizon in some pedons. Reaction ranges from medium acid through moderately alkaline.

Parsons soils are in valleys and are associated on the same landscape with Carytown and Dennis soils. Carytown soils have more exchangeable sodium content in the upper part of the argillic horizon than that of Parsons soils. Dennis soils do not have the abrupt textural change between the A and B horizons characteristic of Parsons soils.

These soils are taxadjuncts to the Parsons series. They have slightly higher base saturation than allowed in the range for the series.

Pawhuska Series

The Pawhuska series consists of deep, nearly level through gently sloping soils on uplands. These soils formed in material weathered from shales interbedded with thin layers of sandstone under a cover of grasses.

The Pawhuska soils are moderately well drained and have very slow permeability. Available water capacity is low.

Typical pedon of Pawhuska silt loam from an area of Corbin-Pawhuska complex, 1 to 5 percent slopes, 500 feet south and 380 feet west of the northeast corner, sec. 11, T. 25 N., R. 4 E.:

A1—0 to 3 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine and medium platy structure parting to fine granular when moist, massive when dry; hard, friable; neutral; abrupt wavy boundary.

B21t—3 to 10 inches; dark brown (7.5YR 3/2) silty clay, dark brown (7.5YR 4/2) dry; moderate medium columnar structure and moderate medium blocky structure parting to strong fine blocky; very hard, firm; nearly continuous clay films on faces of peds; grayish coatings on faces of some prisms; mildly alkaline; clear smooth boundary.

B22t—10 to 18 inches; dark reddish gray (5YR 4/2) silty clay, reddish gray (5YR 5/2) dry; moderate medium blocky structure; extremely hard, firm; nearly continuous clay films on faces of peds; many fine calcium carbonate concretions; moderately alkaline; clear wavy boundary.

B23t—18 to 30 inches; reddish brown (5YR 4/3) silty clay, reddish brown (5YR 5/3) dry; moderate medium blocky structure; extremely hard, firm; nearly continuous clay films on faces of peds; few fine black concretions; many fine calcium carbonate concretions; few soft masses of calcium carbonate; moderately alkaline; gradual smooth boundary.

B24t—30 to 50 inches; reddish brown (5YR 4/3) silty clay loam, reddish brown (5YR 5/3) dry; weak medium blocky structure; extremely hard, firm; patchy clay films on faces of peds; common fine black concretions; common fine calcium carbonate concretions; few fine soft masses of calcium carbonate; moderately alkaline; gradual smooth boundary.

B3—50 to 80 inches; reddish brown (5YR 4/3) silty clay loam, reddish brown (5YR 5/3) dry; weak medium and coarse blocky structure; extremely hard, firm; patchy clay films on faces of peds, common fine black concretions, few fine calcium carbonate concretions, few fine soft masses of calcium carbonate; moderately alkaline.

The thickness of the solum and depth to bedrock ranges from 40 to more than 60 inches. Depth to the water table ranges from 1/2 to 1 foot.

The A1 or Ap horizon is very dark gray or very dark grayish brown. Some pedons have fine brownish, reddish, or yellowish mottles. Reaction ranges from medium acid through slightly acid except in limed areas. In some cultivated areas this horizon is absent. Some pedons have a thin, lighter colored A2 horizon.

The B21t horizon is very dark brown, very dark grayish brown, or dark brown. Mottles are in shades of red or yellow in most pedons. The texture is silty clay loam or silty clay. Reaction ranges from slightly acid through moderately alkaline. The content of exchangeable sodium ranges from 15 to 26 percent in the B21t and B22t horizons. The peds are coated in many places with grayish coatings or black stains.

The lower part of the B2t horizon is dark grayish brown, brown, dark brown, or reddish brown. The texture is silty clay or silty clay loam. Reaction ranges from neutral through moderately alkaline. Fragments of sandstone, shale, or calcium carbonate concretions less than 3 inches in diameter make up from 0 to 5 percent of the volume of the B2t horizon.

The B3 horizon is dark reddish brown or reddish brown. Some pedons are mottled in shades of gray, brown, or red. Texture is silty clay loam or silty clay. Reaction ranges from mildly alkaline through moderately alkaline. Some pedons have soluble salts. Fragments of sandstone, shale, or calcium carbonate concretions less than 3 inches in diameter make up from 0 to 5 percent, by volume, of the horizon. Some pedons have a C horizon of sandstone and shale.

In this county Pawhuska soils are mapped only in complex with Corbin and Norge soils. They are on concave crests and valleys and are associated on the same landscape with Corbin and Norge soils. Corbin and Norge soils have less exchangeable sodium content in the upper part of the argillic horizon than that of Pawhuska soils.

Prue Series

The Prue series consists of deep, gently sloping soils on uplands. These soils formed in material weathered from sandstones and shales under a cover of grasses.

The Prue soils are moderately well drained and have moderately slow permeability. Available water capacity is high.

Typical pedon of Prue loam, 3 to 5 percent slopes, 2,500 feet east and 90 feet south of the center of sec. 18, T. 23 N., R. 10 E.:

A1—0 to 12 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; moderately fine granular structure; slightly hard, very friable; medium acid; gradual smooth boundary.

B1—12 to 18 inches; very dark grayish brown (10YR 3/2) loam, brown (10YR 5/3) dry; few fine faint yellowish brown mottles; weak fine subangular blocky structure parting to moderate medium granular; hard, friable; common worm casts; medium acid; gradual smooth boundary.

B21t—18 to 30 inches; yellowish brown (10YR 5/4) sandy clay loam, light yellowish brown (10YR 6/4) dry; common fine distinct strong brown and few fine distinct yellowish red mottles; weak fine subangular blocky structure; hard, friable; nearly continuous clay films on faces of peds; few worm casts; about 2 percent, by volume, sandstone fragments less than 3 inches in diameter; strongly acid; gradual smooth boundary.

B22t—30 to 39 inches; yellowish brown (10YR 5/4) clay loam, light yellowish brown (10YR 6/4) dry; moderate medium distinct strong brown (7.5YR 5/8) mottles and moderate fine distinct yellowish red mottles; weak medium subangular blocky structure; very hard, firm; nearly continuous clay films on faces of peds; few fine black concretions; slightly acid; gradual smooth boundary.

IIB23t—39 to 50 inches; coarsely mottled strong brown (7.5YR 5/8), grayish brown (2.5Y 5/2), and yellowish red (5YR 5/6) silty clay loam; weak medium blocky structure; extremely hard, very firm; nearly continuous clay films on faces of peds; few fine black concretions; slightly acid; gradual smooth boundary.

IIB3—50 to 72 inches; coarsely mottled strong brown (7.5YR 5/8), grayish brown (2.5Y 5/2), and very dark gray (10YR 3/1) silty clay; weak coarse blocky structure; extremely hard, very firm; nearly continuous clay films on faces of peds; few fine black concretions; moderately alkaline; gradual wavy boundary.

IICr—72 to 96 inches; light olive gray (5Y 6/2) and pale olive (5Y 6/3) laminated shales; brownish yellow (10YR 6/6) streaks; calcareous in spots; few calcium carbonate concretions; moderately alkaline.

The thickness of the solum over bedrock is more than 60 inches. Depth to the water table is more than 6 feet.

The A1 or Ap horizon is very dark brown or very dark grayish brown. Reaction ranges from medium acid through slightly acid except in limed areas.

The B1 horizon is dark brown or very dark grayish brown. Mottles are in shades of brown or red in most pedons. The texture is loam, sandy clay loam, or loam. Reaction ranges from medium acid through strongly acid.

The B21t and B22t horizons are brown, dark brown, dark yellowish brown, or yellowish brown. Most pedons are mottled in shades of brown or red. Some pedons have coarsely mottled matrix colors. The texture is sandy clay loam or clay loam. The reaction ranges from strongly acid through slightly acid.

The IIB23t horizon is coarsely mottled in shades of brown, red, or gray. The texture is silty clay loam or silty clay. Reaction ranges from medium acid through slightly acid. Fragments of sandstone or shale less than 3 inches in diameter make up from 0 to 10 percent of the volume of this horizon. This horizon is not present in all pedons.

The IIB3 horizon, where present, is similar to the IIB23t hoizon in color and texture. Reaction ranges from strongly acid through moderately alkaline. Fragments of sandstone or shale less than 3 inches in diameter make up from 0 to 20 percent, by volume, of this horizon.

The IICr horizon, where present, consists of grayish, yellowish, brownish, or olive shales that are commonly interbedded with lenses of sandstone.

Prue soils are on side slopes and are associated on the same landscape with Bates and Dennis soils. Bates soils have a thinner solum than Prue soils. Dennis soils have a fine control section, and Prue soils have a fine-loamy control section.

Pursley Variant

The Pursley Variant consists of deep, nearly level through very gently sloping soils on flood plains. These soils formed in loamy and sandy sediments under a cover of trees with an understory of grasses. They are subject to flooding.

The Pursley Variant soils are well drained to somewhat excessively drained and have moderately rapid permeability. Available water capacity is low.

Typical pedon of Pursley Variant fine sandy loam, 1,725 feet west and 300 feet south of the northeast corner, sec. 4, T. 24 N., R. 3 E.:

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak medium granular structure; hard, friable; calcareous; moderately alkaline; clear smooth boundary.

A1—6 to 14 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak medium granular structure; hard, friable; mildly alkaline; clear wavy boundary.

C1—14 to 24 inches; dark brown (10YR 4/3) loamy fine sand, pale brown (10YR 6/3) dry; massive; soft, very friable; neutral; clear wavy boundary.

C2—24 to 60 inches; brown (10YR 5/3) fine sand, very pale brown (10YR 7/3) dry; thin lenses of darker finer textured soil materials; loose; slightly acid.

These soils are 20 to 40 inches thick over loose stratified sand. Thickness to bedrock is more than 60 inches. Depth to the water table is more than 6 feet.

The Ap or A1 horizon is very dark gray, dark gray, very dark grayish brown, dark grayish brown, brown, or dark brown. Reaction ranges from mildly alkaline through moderately alkaline.

The C1 horizon is dark gray, dark grayish brown, brown, or dark brown loamy fine sand, fine sand, fine sandy loam, very fine sandy loam, loam, sandy clay loam, or silt loam. Reaction ranges from neutral through moderately alkaline. Thin strata of lighter colored material are in some pedons.

The C2 horizon is brown, dark brown, or pale brown. It is stratified with thin lenses of darker or lighter colored sediments. Reaction ranges from slightly acid through neutral.

Pursley Variant soils are on convex and concave flood plains and are associated with Kiomatia soils. Kiomatia soils have a more sandy control section than Pursley Variant soils.

The Pursley Variant series is a sandy subsoil variant. The soils of this unit are not extensive enough to warrant establishment of a new series.

Roebuck Series

The Roebuck series consists of deep, nearly level, slightly concave soils on flood plains. These soils formed in loamy and clayey sediments under a cover of trees with an understory of grasses. They are subject to flooding.

The Roebuck soils are somewhat poorly drained and have very slow permeability. Available water capacity is medium.

Typical pedon of Roebuck silty clay loam, 480 feet north and 170 feet east of the southwest corner of sec. 34, T. 25 N., R. 3 E.:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak medium granular structure; hard, friable; neutral; clear smooth boundary.

A1—9 to 11 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; very hard, firm; neutral; clear smooth boundary.

B21—11 to 21 inches; reddish brown (5YR 4/3) silty clay, reddish brown (5YR 5/3) dry; moderate fine blocky structure; very hard, very firm; few worm casts; moderately alkaline; clear wavy boundary.

B22b—21 to 27 inches; dark brown (10YR 3/3) silty clay, brown to dark brown (7.5YR 4/2) dry; weak medium blocky structure; extremely hard, very firm; few worm casts; moderately alkaline; clear wavy boundary.

IIAb—27 to 38 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; few fine distinct strong brown mottles; weak medium granular structure; hard, firm; moderately alkaline; gradual wavy boundary.

IIB2b—38 to 52 inches; brown (7.5YR 4/2) clay loam, brown (7.5YR 5/2) dry; common fine distinct strong brown mottles; weak medium subangular blocky structure; hard, firm; moderately alkaline; gradual wavy boundary.

IIICb—52 to 60 inches; brown (7.5YR 4/3) sandy clay loam, brown (7.5YR 5/3) dry; massive; hard, friable; moderately alkaline.

These soils are more than 60 inches thick to bedrock. Depth to the water table ranges from 2 to 3 feet. Most pedons have buried horizons 20 to 40 inches below the surface.

The A1 or Ap and IIAb horizons are very dark brown, very dark grayish brown, or dark brown. Reaction ranges from medium acid through neutral in the A1 or Ap horizon and from neutral through moderately alkaline in the IIAb horizon. Some pedons have a B1 horizon that is similar to the A horizon in color, texture, and reaction.

The B21 horizon is dark reddish brown, reddish brown, or dark brown silty clay loam, clay loam, or silty clay. Reaction ranges from slightly acid through moderately alkaline. Some pedons have a B3 horizon similar to the B2 horizon in color, texture, and reaction.

The IIB2b and B22b horizons are brown or dark brown. Some have brownish or reddish mottles. The textures are silty clay loam, clay loam, or silt clay. Reaction ranges from neutral through moderately alkaline.

The IIICb horizon is dark reddish brown through brown loam, silt loam, clay loam, sandy clay loam, or loam. Reaction ranges from slightly acid through moderately alkaline. The depth to the water table is slightly different than defined in the range for the series; however, this does not affect use and management of the soil.

Roebuck soils are on concave flood plains and are associated on the same landscape with Mason soils. Mason soils have a less clayey control section than Roebuck soils.

Shidler Series

The Shidler series consists of very shallow, very gently sloping through gently sloping soils on uplands. These soils formed in material weathered from limestone and thin layers of chert under a cover of grasses.

The Shidler soils are well drained and have moderate permeability. Available water capacity is low.

Typical pedon of Shidler silty clay loam in an area of Shidler soils, 1 to 5 percent slopes, 600 feet south and 50 feet east of the northwest corner, sec. 18, T. 25 N., R. 9 E.:

A1—0 to 7 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; strong fine and medium granular structure; hard, friable; about 20 percent, by volume, limestone fragments more than 15 inches diameter and 5 percent limestone fragments 3 to 15 inches in diameter; mildly alkaline; abrupt wavy boundary.

R—7 to 8 inches; light gray (10YR 6/1) hard limestone bedrock fractured at intervals of about 2 feet; fractures filled with soil material similar to that in horizon above.

These soils are 4 to 20 inches thick over limestone bedrock. Depth to the water table is more than 6 feet.

The A1 horizon is dark reddish brown, dark brown, very dark brown, or very dark grayish brown silt loam or silty clay loam. The reaction is medium acid through mildly alkaline. Rock fragments occupy less than 35 percent, by volume, of this horizon.

The R layer is grayish or brownish and fractured vertically at intervals of 1 to 6 feet. The fractures are from 1 to 6 inches wide and 4 to 20 inches deep. The bedrock has horizontal bedding plains varying from 2 inches to 48 inches apart, but commonly 4 to 8 inches apart. The thickness of rock strata varies from about 4 inches to 20 feet or more. The strata are interbedded with thin layers of grayish or reddish calcareous shales.

Shidler soils are on crests and are associated on the same landscape with Apperson, Catoosa, Foraker, Grainola, and Summit soils. Shidler soils do not have the argillic horizons characteristic of Apperson, Catoosa, Foraker, Grainola, and Summit soils.

Steedman Series

The Steedman series consists of moderately deep, very gently sloping through steep soils on uplands. These soils formed in material weathered from shales interbedded with thin layers of sandstone under a cover of grasses.

The Steedman soils are well drained to moderately well drained and have slow permeability. Available water capacity is medium.

Typical pedon of Steedman silt loam, in an area of Steedman-Coweta complex, 3 to 15 percent slopes, 2,640 feet south and 500 feet east of the northwest corner, sec. 30, T. 24 N., R. 12 E.:

A1—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; hard, friable; about 20 percent, by volume, sandstone fragments less than 3 inches in diameter and 30 percent, by volume, sandstone fragments from 3 to 10 inches in diameter; slightly acid; clear smooth boundary.

B21t—8 to 17 inches; brown (7.5YR 4/2) silty clay, brown (7.5YR 5/2) dry; many fine distinct yellowish red mottles; strong medium and coarse granular structure; very hard, firm; nearly continuous clay films on faces of peds; medium acid; gradual smooth boundary.

B22t—17 to 23 inches; dark grayish brown (10YR 4/2) silty clay, grayish brown (10YR 5/2) dry; many fine distinct strong brown mottles and common fine distinct yellowish red mottles; moderate medium blocky structure; very hard, very firm; nearly continuous clay films on faces of peds; few fine black concretions; slightly acid; gradual smooth boundary.

B3—23 to 28 inches; coarsely mottled dark gray (10YR 4/1), grayish brown (2.5Y 5/2), and yellowish brown (10YR 5/6) silty clay; weak medium and coarse blocky structure; very hard, very firm; few fine black concretions; about 30 percent, by volume, laminated shale fragments less than 3 inches in diameter; neutral; gradual smooth boundary.

Cr—28 to 60 inches; grayish brown (2.5Y 5/2) soft shale bedrock with yellowish brown (10YR 5/8) streaks; calcareous below 38 inches, moderately alkaline. Stony phases are present.

These soils are 20 to 40 inches thick over bedrock of shale that is interbeldded with lenses of sandstone. Depth to the water table ranges from 1/2 to 1 foot.

The A1 horizon is very dark brown, very dark grayish brown, or dark brown. Reaction ranges from medium acid through slightly acid. Sandstone fragments more than 3 inches in diameter make up from 0 to 5 percent, by volume, of the horizon, and sandstone fragments less than 3 inches in diameter make up from 0 to 25 percent.

The B21t horizon is reddish brown, dark brown, brown, very dark grayish brown, dark grayish brown, or grayish brown. Most pedons have reddish or brownish mottles. The texture is clay or silty clay. Reaction ranges from medium acid through slightly acid. Sandstone fragments less than 3 inches in diameter make up from 0 to 25 percent, by volume, of the horizon. Some pedons have a B1 horizon that is similar to the B21t horizon in color, texture, and reaction.

The B22t horizon is reddish brown, brown, dark brown, dark grayish brown, grayish brown, dark yellowish brown, or olive brown. Mottles are shades of gray, brown, or red in most pedons. Reaction ranges from medium acid through slightly acid.

The B3 horizon is commonly coarsely mottled in shades of gray, brown, yellow, or red. Some pedons have dominant matrix colors of grayish brown, dark grayish brown, light olive brown, or olive brown with mottles in shades of gray, brown, yellow, or red. Reaction ranges from neutral through moderately alkaline. Shale or sandstone fragments less than 3 inches in diameter make up from 0 to 35 percent, by volume, of the horizon and fragments more than 3 inches in diameter make from 0 to 10 percent, by volume.

The Cr horizon is soft reddish, grayish, or olive shale mottled or streaked with black, gray, brown, yellow, or reddish colors. It is interbedded with thin lenses of brownish or reddish sandstone.

Steedman soils are on crests and side slopes and are associated on the same landscape with Bates, Coweta, and Dennis soils. Bates and Coweta soils have a less clayey control section than the Steedman soils. Dennis soils have a thicker solum than the Steedman soils.

Stephenville Series

The Stephenville series consists of moderately deep, very gently sloping through sloping soils on uplands. These soils formed in material weathered from sandstones under a cover of trees with an understory of grasses.

The Stephenville soils are well drained and have moderate permeability. Available water capacity is medium.

Typical pedon of Stephenville fine sandy loam, in an area of Darnell-Stephenville complex, 1 to 8 percent slopes, 800 feet east and 20 feet north of the southwest corner, sec. 23, T. 27 N., R. 10 E.:

A1—0 to 3 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak medium granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

A2—3 to 8 inches; brown (10YR 4/3) fine sandy loam, brown (10YR 5/3) dry; weak fine granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

B21t—8 to 14 inches; strong brown (7.5YR 4/6) sandy clay loam, strong brown (7.5YR 5/6) dry; few fine faint strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; very hard, firm; nearly continuous clay films on faces of peds; medium acid; gradual smooth boundary.

B22t—14 to 21 inches; strong brown (7.5YR 4/6) sandy clay loam, strong brown (7.5YR 5/6) dry; common medium distinct yellowish red (5YR 5/6) mottles; moderate medium subangular blocky structure; very hard, firm; nearly continuous clay films on faces of peds; strongly acid; gradual smooth boundary.

B3—21 to 26 inches; coarsely mottled strong brown (7.5YR 5/6), red (2.5YR 4/6), dark red (2.5YR 3/6), and brown (10YR 5/3) sandy clay loam; weak medium subangular blocky structure; very hard, firm; patchy clay films on faces of peds; strongly acid; clear irregular boundary.

Cr—26 to 30 inches; strong brown (7.5YR 5/8), yellowish red (5YR 4/6), light yellowish brown (2.5Y 6/4), and red (2.5YR 4/6) soft acid sandstone bedrock.

The thickness to sandstone bedrock is 20 to 40 inches. Depth to the water table is more than 6 feet.

The A1 horizon is dark brown, very dark brown, or very dark grayish brown. Reaction ranges from medium acid through slightly acid except in limed areas.

The A2 horizon is brown, dark grayish brown, or grayish brown. Reaction ranges from strongly acid through slightly acid.

The B2t horizon is reddish brown, yellowish red, brown, dark brown, or strong brown. Mottles are shades of red, yellow, or brown in most pedons. Reaction ranges from strongly acid through medium acid.

The B3 horizon is similar to the B2t horizon in color and reaction, but it and varies in texture from fine sandy loam to sandy clay loam. Sandstone fragments less than 3 inches in diameter make up as much as 30 percent, by volume, of this horizon. In many places the Cr horizon sandstone is interbedded with thin lenses of grayish shales.

Stephenville soils are on side slopes and are associated on the same landscape with Darnell, Gasil, and Niotaze soils. Darnell soils have a thinner solum and Gasil soils a thicker solum than the solum of Stephenville soils. Niotaze soils have a more clayey control section than the Stephenville soils.

These soils are taxadjuncts to the Stephenville series. About 80 percent of the pedons have yellower colors in the subsoil than are allowed in the range for the Stephenville series (7.5YR hue rather than 5YR or redder).

Stoneburg Series

The Stoneburg series consists of moderately deep, gently sloping through strongly sloping soils on uplands. These soils formed in material weathered from sandstone under a cover of grasses.

The Stoneburg soils are well drained and have moderate permeability. Available water capacity is medium.

Typical pedon of Stoneburg fine sandy loam, in an area of Stoneburg-Lucien complex, 3 to 12 percent slopes, 2,320 feet west and 1,050 feet south of the northeast corner, sec. 12, T. 27 N., R. 5 E.:

A1—0 to 10 inches; dark brown (7.5YR 3/2) fine sandy loam, brown to dark brown (7.5YR 4/2) dry; weak fine granular; hard, very friable; medium acid; clear smooth boundary.

B1—10 to 14 inches; dark reddish brown (5YR 3/3) fine sandy loam, reddish brown (5YR 5/3) dry; weak fine subangular blocky structure parting to moderate medium granular structure; hard, friable; medium acid; clear smooth boundary.

B2t—14 to 23 inches; reddish brown (5YR 4/3) sandy clay loam, reddish brown (5YR 5/3) dry; few fine distinct red mottles; weak medium subangular blocky structure; very hard, friable; patchy clay films on faces of peds; about 5 percent, by volume, sandstone fragments less than 3 inches in diameter; medium acid; clear smooth boundary.

B3—23 to 27 inches; reddish brown (5YR 4/4) sandy clay loam, reddish brown (5YR 5/4) dry; weak medium subangular blocky structure; very hard, friable; patchy clay films on faces of peds; about 30 percent, by volume, coarse fragments less than 3 inches in diameter; medium acid; abrupt irregular boundary.

Cr—27 to 30 inches; soft, reddish brown sandstone bedrock, partly weathered in upper part.

These soils are 20 to 40 inches thick over sandstone bedrock. Depth to the water table is more than 6 feet.

The A1 horizon is dark brown, very dark brown, or very dark grayish brown. Reaction ranges from medium acid through slightly acid.

The B1 horizon is dark brown or dark reddish brown loam or fine sandy loam. Reaction ranges from medium acid though slightly acid.

The B2t horizon is brown, dark brown, or reddish brown. Reddish or brownish mottles are in some pedons. The texture is clay loam or sandy clay loam. Reaction ranges from medium acid through slightly acid. Sandstone fragments less than 3 inches in diameter make up from 0 to 10 percent, by volume, of the horizon.

The B3 horizon is similar to the B2t horizon in color, texture, and reaction, but sandstone fragments less than 3 inches in diameter make up from 0 to 40 percent, by volume, of the horizon.

The Cr horizon is reddish or brownish. The sandstone is commonly interbedded with lenses of reddish or grayish shales.

Stoneburg soils are on crests and side slopes and are associated on the same landscape with Lucien soils. Lucien soils do not have the argillic horizons characteristic of Stoneburg soils.

Summit Series

The Summit series consists of deep, gently sloping through strongly sloping soils on uplands. These soils formed in material weathered from shales under a cover of grasses.

The Summit soils are moderately well drained and have slow permeability. Available water capacity is high.

Typical pedon of Summit silty clay loam, 3 to 5 percent slopes, 2,080 feet south and 200 feet west of the northeast corner, sec. 27, T. 28 N., R. 8 E.:

A1—0 to 9 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; strong medium granular structure; hard, friable; slightly acid; gradual smooth boundary.

B1—9 to 17 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; strong medium granular structure; very hard, firm; slightly acid; gradual smooth boundary.

B21t—17 to 26 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; common medium distinct dark grayish brown (2.5Y 4/2) mottles and few fine distinct light olive brown mottles; moderate medium blocky structure parting to strong medium granular; very hard, very firm; nearly continuous clay films or pressure faces on faces of peds; few fine black concretions; few fine chert pebbles; neutral; gradual smooth boundary.

B22t—26 to 34 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; with few vertical black streaks because of soil cracking; common medium distinct black (10YR 2/1) mottles and few fine distinct strong brown mottles; moderate medium blocky structure; very hard, very firm; nearly continuous pressure faces or clay films on faces of peds; common fine black concretions; moderately alkaline; gradual smooth boundary.

B23t—34 to 57 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; few vertical black streaks because of soil cracking; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium and coarse blocky structure; very hard, very firm; nearly continuous pressure faces or clay films on faces of peds; common fine black concretions; few slickensides; few lime concretions; moderately alkaline; gradual smooth boundary.

B3—57 to 72 inches; coarsely mottled light olive brown (2.5Y 5/4), grayish brown (2.5Y 5/2), yellowish brown (10YR 5/6), and gray (10YR 5/1) silty clay; weak coarse blocky structure; very hard, very firm; patchy pressure faces or clay films on faces of peds; common fine black concretions; few lime concretions; calcareous, moderately alkaline.

These soils are more than 60 inches thick to shale bedrock. They tend to crack when dry. Depth to the water table ranges from 1 to 2 feet.

The A1 or Ap horizon is black, very dark gray, or very dark brown. Reaction ranges from medium acid through slightly acid except in limed areas. Coarse fragments less than 3 inches in diameter make up from 0 to 10 percent, by volume, of the horizon, and fragments 3 to 15 inches in diameter make up from 0 to 15 percent.

The B1 horizon has the same range in color, content of coarse fragments, and reaction as the A1 horizon. The texture is silty clay loam or silty clay.

The B21t horizon is black, very dark gray, very dark brown, or very dark grayish brown. Some pedons have grayish, brownish, or yellowish mottles. Reaction ranges from slightly acid through neutral.

The B22t and B23t horizons are very dark grayish brown, dark grayish brown, dark yellowish brown, or olive brown. Mottles are shades of gray, brown, yellow, or red in most pedons. Reaction ranges from slightly acid through moderately alkaline. Chert or limestone fragments less than 3 inches in diameter make up from 0 to 10 percent, by volume, of these horizons. Lime concretions are in the lower parts of these horizons in some profiles.

The B3 horizon is mostly coarsely mottled in shades of gray, brown, yellow, or red. Reaction ranges from mildly alkaline through moderately alkaline. Coarse fragments of limestone or chert less than 3 inches in diameter make up from 0 to 25 percent, by volume, of the horizon, and fragments 3 to 15 inches in diameter make up from 0 to 10 percent, by volume.

In some places a C horizon is present below a depth of 60 inches. It consists mainly of grayish or olive calcareous shales interbedded with lenses of limestone.

Summit soils are on side slopes and are associated on the same landscape with Apperson, Foraker, and Shidler soils. Apperson, Foraker, and Shidler soils have a thinner solum than that of the Summit soils.

Teller Series

The Teller series consists of deep, gently sloping soils on uplands. These soils formed in loamy sediments under a cover of grasses.

The Teller soils are well drained and have moderate permeability. Available water capacity is high.

Typical pedon of Teller loam, 3 to 5 percent slopes, 2,450 feet east and 1,800 feet north of the southwest corner, sec. 4, T. 24 N., R. 4 E.:

Ap—0 to 8 inches; dark brown (7.5YR 3/2) loam, brown (7.5YR 5/2) dry; weak fine platy structure parting to weak fine granular; hard, friable; few worm casts; medium acid; clear smooth boundary.

B1—8 to 14 inches; dark brown (7.5YR 3/2) loam, brown to dark brown (7.5YR 4/2) dry; weak medium prismatic structure parting to moderate medium granular; very hard, friable; common worm casts; slightly acid; gradual smooth boundary.

B21t—14 to 32 inches; dark reddish brown (5YR 3/4) clay loam, reddish brown (5YR 4/4) dry; weak medium subangular blocky structure; very hard, firm; patchy clay films on faces of peds; few worm casts; slightly acid; gradual smooth boundary.

B22t—32 to 52 inches; reddish brown (5YR 4/4) clay loam, reddish brown (5YR 5/4) dry; weak medium subangular blocky structure; very hard, firm; patchy clay films on faces of peds; slightly acid; gradual smooth boundary.

B3—52 to 60 inches; reddish brown (5YR 4/4) loam, reddish brown (5YR 5/4) dry; weak medium subangular blocky structure; very hard, friable; patchy clay films on faces of peds; slightly acid.

These soils are more than 60 inches thick to bedrock. Depth to the water table is more than 6 feet.

The A1 or Ap horizon is dark brown or very dark grayish brown. Reaction ranges from medium acid through slightly acid except in limed areas.

The B1 horizon is dark reddish brown or dark brown. Reaction ranges from medium acid through slightly acid.

The B2t horizon is dark reddish brown, reddish brown, or yellowish red clay loam or sandy clay loam. Reaction ranges from medium acid through slightly acid.

The B3 horizon is similar in color to the B2t horizon except that in some pedons it has brownish or reddish mottles. The texture is fine sandy loam or loam. Reaction ranges from medium acid through neutral.

In some pedons a Cr horizon is below a depth of 60 inches. The Cr horizon is similar to the B3 horizon except that it contains less clay and more sand.

Teller soils are on side slopes and are associated on the same landscape with Minco and Norge soils. Minco soils have a coarse-silty control section, Norge soils have a fine-silty control section, and Teller soils have a fine-loamy control section.

Vanoss Series

The Vanoss series consists of deep, nearly level through very gently sloping soils on uplands. These soils formed in loamy sediments under a cover of grasses.

The Vanoss soils are well drained and have moderate permeability. Available water capacity is high.

Typical pedon of Vanoss silt loam, 0 to 1 percent slopes, 1,300 feet south and 100 feet west of the northeast corner, sec. 1, T. 25 N., R. 3 E.:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; slightly hard, very friable; medium acid; clear smooth boundary.

A1—9 to 12 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; slightly hard, very friable; medium acid, clear smooth boundary.

B1—12 to 19 inches; dark brown (10YR 3/3) silty clay loam, brown to dark brown (10YR 4/3) dry; weak subangular blocky structure parting to moderate medium granular; hard, friable; medium acid; gradual smooth boundary.

B21t—19 to 38 inches; brown (7.5YR 4/4) silty clay loam, brown (7.5YR 5/4) dry; moderate medium subangular blocky structure; very hard, firm; nearly continuous clay films on faces of peds; slightly acid; gradual smooth boundary.

B22t—38 to 56 inches; brown (7.5YR 4/4) silty clay loam, brown (7.5YR 5/4) dry; few fine distinct strong brown mottles; weak medium subangular blocky structure; very hard, firm; patchy clay films on faces of peds; slightly acid; gradual smooth boundary.

B3—56 to 72 inches; brown (7.5YR 4/4) clay loam, brown (7.5YR 5/4) dry; many fine distinct strong brown mottles; weak medium subangular blocky structure; very hard, firm; patchy clay films on faces of peds; few fine black concretions; slightly acid.

These soils are more than 60 inches thick to bedrock. Depth to the water table is more than 6 feet.

The Ap or A1 horizon is very dark brown, very dark grayish brown, or dark brown. Reaction ranges from medium acid through slightly acid except in limed areas.

The B1 horizon is very dark grayish brown, dark brown, or dark yellowish brown clay loam or silty clay loam. Reaction ranges from medium acid through slightly acid.

The B2t horizon is brown, dark brown, or dark yellowish brown and has brownish or reddish mottles in the lower part in places. Reaction ranges from medium acid through slightly acid.

The B3 horizon is brown, dark brown, or dark yellowish brown. Many pedons have brownish or reddish mottles. The texture is loam, clay loam, or silty clay loam. Reaction ranges from medium acid through slightly acid.

Some pedons have a C horizon below a depth of 50 inches. This horizon is similar to the B3 horizon in color and texture. Reaction ranges from slightly acid through neutral.

Vanoss soils are on crests and side slopes and are associated on the same landscape with Norge soils. The argillic horizon in Norge soils has color in hue of 5YR or redder, and the argillic horizon in Vanoss soils is more yellowish.

Verdigris Series

The Verdigris series consists of deep, nearly level through very gently sloping soils on flood plains. These soils formed in loamy sediments under a cover of trees with an understory of grasses. They are subject to flooding.

The Verdigris soils are moderately well drained and have moderate permeability. Available water capacity is high.

Typical pedon of Verdigris silt loam, 2,600 feet north and 300 feet west of the southeast corner, sec. 30, T. 29 N., R. 11 E.:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; slightly hard, very friable; common worm casts; medium acid; clear smooth boundary.

A1—7 to 21 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; hard, friable; common worm casts; slightly acid; gradual smooth boundary.

AC—21 to 42 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; few fine faint strong brown mottles; thin dark grayish brown strata; weak medium subangular blocky structure parting to moderate medium granular; hard, firm; common worm casts; medium acid; gradual smooth boundary.

AC2—42 to 72 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; many medium distinct strong brown (7.5YR 5/6) mottles and few medium faint grayish brown (10YR 5/2) mottles; weak medium blocky structure; very hard, very firm; patchy clay films on faces of peds; few fine black concretions; medium acid.

Bedrock is at a depth of more than 60 inches. Depth to the water table ranges from 2 to 3 feet. The reaction of all horizons ranges from medium acid through neutral unless the soil has been limed.

The Ap or A1 horizon is black, very dark gray, very dark brown, very dark grayish brown, or dark brown.

The AC horizon is very dark brown, very dark gray, very dark grayish brown, or dark brown. Mottles in shades of red, brown, or yellow are below a depth of 20 inches in most pedons. The texture is silt loam, silty clay loam, or clay loam. Thin strata of lighter or darker colors and finer or coarser textures are in many pedons.

The C horizon, where present, is very dark grayish brown, dark grayish brown, brown, dark brown, or grayish brown. Mottles are shades of gray, brown, yellow, or red in most pedons. The texture is silt loam or silty clay loam. Buried horizons are below a depth of 40 inches in some pedons. Lime accumulations are below a depth of 50 inches in some pedons.

These soils have a water table that is closer to the surface during some period of the year than is defined in the range for the series; however, use and management are the same. Verdigris soils are on flood plains and are associated on the same landscape with Barnsdall, Cleora, Mason, and Wynona soils. Barnsdall and Mason soils have argillic horizons that are not present in Verdigris soils. Cleora soils are less clayey than Verdigris soils, and Wynona soils are wetter than Verdigris soils.

Wolco Series

The Wolco series consists of deep, nearly level through very gently sloping soils on uplands. These soils formed in material weathered from limestone and shale under a cover of grasses.

The Wolco soils are moderately well drained and have slow permeability. Available water capacity is high.

Typical pedon of Wolco silty clay loam, 1 to 3 percent slopes, 1,800 feet north and 30 feet west of the southeast corner, sec. 13, T. 28 N., R. 6 E.:

A1—0 to 14 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium granular structure; hard, friable; medium acid; gradual smooth boundary.

B1—14 to 21 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; weak medium subangular blocky structure parting to strong medium granular; very hard, firm; slightly acid; gradual smooth boundary.

B21t—21 to 36 inches; coarsely mottled dark brown (7.5YR 4/2), yellowish red (5YR 4/6), and very dark grayish brown (10YR 3/2) silty clay, brown (7.5YR 5/2) dry, yellowish red (5YR 5/6) dry, and dark grayish brown (10YR 4/2) dry; moderate medium blocky structure parting to strong medium granular; extremely hard, very firm; nearly continuous clay films or pressure faces on faces of peds; few fragments of chert less than 3 inches in diameter; neutral; gradual smooth boundary.

B22t—36 to 55 inches; coarsely mottled yellowish red (5YR 4/6) and dark grayish brown (10YR 4/2) silty clay, yellowish red (5YR 5/6) dry and grayish brown (10YR 5/2) dry; moderate medium blocky structure; extremely hard, very firm; nearly continuous clay films or pressure faces on faces of peds; few fine black concretions; about 10 percent, by volume, fragments of chert less than 3 inches in diameter; moderately alkaline; clear irregular boundary.

R—55 to 60 inches; hard limestone bedrock, coarsely fractured.

These soils are 40 to 60 inches thick over hard limestone bedrock. Depth to the water table ranges from 1 1/2 to 2 1/2 feet.

The Ap or A1 horizon is black, very dark gray, very dark brown, dark brown, or very dark grayish brown. Reaction ranges from medium acid through slightly acid except in limed areas.

The B1 horizon is very dark brown, very dark grayish brown, or dark brown. A few reddish or yellowish mottles are in some pedons. Reaction ranges from medium acid through slightly acid.

The B2t horizon is brown, dark brown, dark reddish brown, or reddish brown. Mottles are shades of brown, red, or gray in most pedons. The texture is silty clay loam or silty clay. Reaction ranges from slightly acid through moderately alkaline. Chert fragments less than 3 inches in diameter make up from 0 to 10 percent, by volume, of the horizon. Lime concretions are in the lower part of the horizon in some pedons.

Some pedons have a B3 horizon that is reddish brown, dark reddish brown, or yellowish red. Reddish, yellowish, or brownish mottles are in some pedons. Reaction ranges from neutral through mildly alkaline. Chert or limestone fragments less than 3 inches in diameter make up from 0 to 25 percent, by volume, of the horizon, and fragments 3 to 15 inches in diameter make up from 0 to 10 percent, by volume. Lime concretions are in some pedons.

The Wolco soils are on crests and are associated on the same landscape with Apperson and Dwight soils. Apperson soils are slightly darker than Wolco soils. Dwight soils have a higher amount of exchangeable sodium in the upper part of the argillic horizon than that of the Wolco soils.

Wynona Series

The Wynona series consists of deep, nearly level soils on flood plains. These soils formed in loamy sediments under a cover of trees with an understory of grasses. They are subject to flooding.

The Wynona soils are somewhat poorly drained and have slow permeability. Available water capacity is high.

Typical pedon of Wynona silty clay loam, 1,900 feet south and 70 feet west of the northeast corner, sec. 9, T. 21 N., R. 12 E.:

A1—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium granular structure; slightly hard, friable; slightly acid; gradual smooth boundary.

B21g—8 to 23 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; few fine distinct yellowish red mottles; weak medium subangular blocky structure parting to moderate medium granular; hard, firm; medium acid; gradual smooth boundary.

B22g—23 to 35 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; common fine distinct strong brown mottles; weak medium subangular blocky structure; hard, firm; medium acid; gradual smooth boundary.

B31g—35 to 47 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; common medium distinct strong brown (7.5YR 5/6) mottles; weak medium blocky structure; hard, firm; common fine black concretions; medium acid; gradual smooth boundary.

B32g—47 to 63 inches; dark gray (10YR 4/1) silty clay, gray (10YR 5/1) dry; common coarse distinct strong brown (7.5YR 5/6) mottles and few fine distinct light brownish gray mottles; weak medium blocky structure; hard, firm; few fine black concretions; medium acid.

These soils are more than 72 inches thick to bedrock. Depth to the water table ranges from 0 to 2 feet.

The A1 or Ap horizon is black, very dark gray, very dark brown, or very dark grayish brown. Reaction ranges from medium acid through slightly acid.

The B21g horizon is very dark gray, very dark brown, very dark grayish brown, or black. Mottles are shades of red or brown. Reaction ranges from strongly acid through slightly acid.

The B22g horizon is very dark gray, very dark grayish brown, or dark grayish brown, and is mottled in shades of gray, brown, or red. Reaction ranges from strongly acid through medium acid.

The B3g horizon is commonly coarsely mottled in shades of red, brown, or gray. Some pedons have dominant matrix colors of very dark gray, very dark grayish brown, or dark gray with mottles in shades of red, brown, or gray. The texture is silty clay loam or silty clay. Reaction ranges from strongly acid through medium acid. Some pedons have buried horizons below a depth of 40 inches.

Wynona soils are on concave flood plains and are associated on the same landscape with Osage and Verdigris soils. Osage soils have a more clayey control section than the Wynona soils. Verdigris soils are less wet than Wynona soils.

Classification

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Readers interested in further details about the system should refer to the "Unedited Text of the National Cooperative Soil Survey" available at the State Office, Stillwater, Oklahoma.

The system of classification has six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the classification is based on the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In table 19, the soils of the survey area are classified according to the system. Categories of the system are discussed in the following paragraphs.

ORDER. Ten soil orders are recognized as classes in the system. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders based primarily on properties that influence soil genesis and are important to plant growth or that are selected to reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquent (*Aqu*, meaning water, plus *ent*, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of expression of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and a prefix that suggests something about the properties of the soil. An example is Haplaquents (*Hapl*, meaning simple horizons, plus *aquent*, the suborder of Entisols that have an aquic moisture regime).

SUBGROUP. Each great group may be divided into three subgroups: the central (typic) concept of the great groups, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extragrades, which have some properties that are representative of the great groups but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceeding the name of the great group. The adjective *Typic* identifies for the subgroup that is thought to typify the great group. An example is Typic Hapludalfs.

FAMILY. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineral content, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, soil slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiae. An example is fine-silty, mixed, thermic, Typic Hapludalfs.

SERIES. The series consists of soils that formed in a particular kind of material and have horizons that, except for texture of the surface soil or of the underlying substratum, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineral and chemical composition.

Formation of the Soils

Soil is a natural three-dimensional body on the earth's surface. It supports plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material as conditioned by relief over a period of time.

The interaction of five main factors results in differences among the soils. These factors are the physical and chemical composition of the parent material, the climate during and after the accumulation of the parent material, the kinds of plants and organisms living in the soil, the relief of the land and its effect on runoff, and the length of time it took the soil to form.

The soils in the survey area formed mainly in material weathered from shale; limestone; sandstone; and loamy,

clayey, and sandy sediments. Some of the soils that formed in materials weathered from shale are Carytown, Dennis, Foraker, Grainola, Niotaze, Okemah, Pawhuska, Steedman, and Summit soils. Some of the soils that formed in materials weathered from sandstone are Bates, Coweta, Darnell, Lucien, Stephenville, and Stoneburg soils. Some of the soils that formed in material weathered from limestone are Apperson, Catoosa, Lula, Shidler, and Wolco soils. Some of the soils that formed in materials weathered from loamy sediments are Barnsdall, Choska, Cleora, Mason, Minco, Norge, Teller, Vanoss, and Verdigris soils. Examples of soils that formed in materials weathered from clayey sediments are Lightning and Osage soils; examples of soils that formed in sandy sediments are Eufaula and Kiomatia soils.

The type of vegetation and living organisms has affected the losses and gains of organic matter and plant nutrients and the structure and porosity of the soils. Dennis and Coweta soils are examples of soil that formed under grasses; Stephenville and Darnell soils are examples of soils that formed under trees.

Differences between soils in Osage County cannot be attributed to climate because the climate over the survey area is nearly uniform.

The relief has had some influence on the formation of soils in the survey area. The relief is determined largely by the resistance of the underlying bedrock to weathering and geological erosion. Relief effects the formation of soils through its infuence on moisture, drainage, erosion, temperature of the soil, and plant cover. Soils such as Parsons soils are less sloping and, therefore, have more strongly developed profiles than, for example, the profiles of the steeper Steedman soils. Both soils formed in materials weathered from shale.

Time cannot be measured strictly in years because the length of time needed for a soil to develop horizons depends on the intensity and interaction of the soil forming processes. Horizon development indicates Parsons soils, for example, are old; Cleora soils are young.

References

(1) American Association of State Highway [and Transportation] Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 vol., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplement issued May 1962]

Glossary

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim. 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 mapping 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—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	More than 9

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to frequent flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Broad-base terrace. A ridge-type terrace built to control erosion by diverting runoff along the contour at a nonscouring velocity. The terrace is 10 to 20 inches high and 15 to 30 feet wide and has gently sloping sides, a rounded crown, and a dish-shaped channel along the upper side. It may be nearly level or have a grade toward one or both ends.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Cement rock. (Local) Shaly limestone used in the manufacture of cement.

Channery soil. A soil, that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a fragment.

Chiseling. Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

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 coat, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. Mineral or rock particles up to 3 inches (2 millimeters to 7.5 centimeters) in diameter.

Coarse textured (light 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 bases of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures is difficult.

Complex, soil. A mapping unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

Compressible. Excessive decrease in volume of soft soil under load.

Congeliturbate. Soil material disturbed by frost action.

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.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

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 40 or 80 inches (1 or 2 meters).

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave. Unstable walls of cuts made by earthmoving equipment. The soil sloughs easily.

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. A delay in grazing until range plants have reached a specified stage of growth. Grazing is deferred in order to increase the vigor of forage and to allow desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

Delta. An alluvial deposit, commonly triangular in shape, formed largely beneath water and deposited at the mouth of a river or stream.

Depth to rock. Bedrock at a depth that adversely affects the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for 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, as for example in "hillpeats" and "climatic moors."

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by running 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 a bare surface.

Erosion pavement. A layer of gravel or stones that remains on the ground surface after fine particles are removed by wind or water. Desert pavements result from wind erosion in arid areas.

Excess alkali. Excess exchangeable sodium. The resulting poor physical properties restrict the growth of plants.

Excess fines. Excess silt and clay. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime. Excess carbonates. Excessive carbonates, or lime, restrict the growth of some plants.

Excess salts. Excess water soluble salts. Excessive salts restrict the growth of most plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake. The rapid movement of water into the soil.

Favorable. Favorable soil features for the specified use.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Fine textured (heavy textured) soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 37.5 centimeters) long.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; *November-May*, for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered flooding.

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.

Forage. Plant material used as feed by domestic animals. Forage can be grazed or cut for hay.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action. Freezing and thawing of soil moisture. Frost action can damage structures and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai. Typically, the microrelief of Vertisols—clayey soils having a high coefficient of expansion and contraction with changes in moisture content. Commonly a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope.

Gleyed soil. A soil having one or more neutral gray horizons as a result of waterlogging and lack of oxygen. The term "gleyed" also designates gray horizons and horizons having yellow and gray mottles as a result of intermittent waterlogging.

Graded stripcropping. Growing crops in strips that grade toward a protected waterway.

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 from 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Green manure (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table, which is the upper limit of saturation.

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.

Gypsum. Hydrous calcium sulphate.

Habitat. The natural abode of a plant or animal; refers to the kind of environment in which a plant or animal normally lives, as opposed to the range or geographical distribution.

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. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming 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.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks 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 from which the solum is presumed to have 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.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered, but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants are those that follow 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.

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.

Landslide. The rapid downhill movement of a mass of soil and loose rock generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones. Rock fragments 10 inches (25 centimeters) or more across. Large stones adversely affect the specified use.

Leaching. The removal of soluble material from soil or other material by percolating water.

Light textured soil. Sand and loamy sand.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. Inadequate strength for supporting loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is greater than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous areas. Areas that have little or no natural soil, are too nearly inaccessible for orderly examination, or cannot otherwise be feasibly classified.

Moderately coarse textured (moderately light textured) soil. Sandy loam and fine sandy loam.

Moderately fine textured (moderately heavy textured) soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three single 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.

Narrow-base terrace. A terrace no more than 4 to 8 feet wide at the base. A narrow-base terrace is similar to a broad-base terrace, except for the width of the ridge and channel.

Neutral soil. A soil having a pH value between 6.6 and 7.3.

Nutrient, plant. Any element taken in by a plant, essential to its growth, and used by it in the production of food and tissue. Plant nutrients are nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps other elements obtained from the soil; and carbon, hydrogen, and oxygen obtained largely from the air and water.

Pan. A compact, dense layer in a soil. A pan impedes the movement of water and the growth of roots. The word "pan" is commonly combined with other words that more explicitly indicate the nature of the layer; for example, *hardpan*, *fragipan*, *claypan*, *plowpan*, and *traffic pan*.

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly. The slow movement of water through the soil adversely affecting the specified use.

Permafrost. Layers of soil, or even bedrock, occurring in arctic or subarctic regions, in which a temperature below freezing has existed continuously for a long time.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves

through the 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 to 2.0 inches), *moderately rapid* (2.0 to 6.0 inches), *rapid* (6.0 to 20 inches), and *very rapid* (more than 20 inches).

Phase, soil. A subdivision of a soil series or other unit in the soil classification system based on differences in the soil that affect its management. A soil series, for example, may be divided into phases on the bases of differences in slope, stoniness, thickness, or some other characteristics that affects management. These differences are too small to justify separate series.

pH value. (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

Piping. Moving water of subsurface tunnels or pipelike cavities in the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from a semisolid to a plastic state.

Plinthite. The sesquioxide-rich, humus-poor, highly weathered mixture of clay with quartz and other diluents that commonly appears as red mottles, usually in platy, polygonal, or reticulate patterns. Plinthite changes irreversibly to an ironstone hardpan or to irregular aggregates on exposure to repeated wetting and drying, especially if it is exposed also to heat from the sun. In a moist soil, plinthite can be cut with a spade, whereas ironstone cannot be cut but can be broken or shattered with a spade. Plinthite is one form of the material that has been called laterite.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Polypedon. A volume of soil having properties within the limits of a soil series, the lowest and most homogeneous category of soil taxonomy. A "soil individual."

Poorly graded. Refers to soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor outlets. Surface or subsurface drainage outlets difficult or expensive to install.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under a specified system of management. Productivity is measured in terms of output, or harvest, in relation to input.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Range (or rangeland). Land that, for the most part, produces native plants suitable for grazing by livestock; includes land supporting some forest trees.

Range condition. The health or productivity of forage plants on a given range, in terms of the potential productivity under normal climate and the best practical management. Condition classes generally recognized are—*excellent, good, fair,* and *poor.* The classification is based on the percentage of original, or assumed climax vegetation on a site, as compared to what has been observed to grow on it when well managed.

Range site. An area of range where climate, soil, and relief are sufficiently uniform to produce a distinct kind and amount of native vegetation.

Reaction, soil. The degree 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—

	pH
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

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock. Soil scientists regard as soil only the part of the regolith that is modified by organisms and other soil-building forces. Most engineers describe the whole regolith, even to a great depth, as "soil."

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulates over disintegrating rock.

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.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth. Shallow root zone. The soil is shallow over a layer that greatly restricts roots. See Root zone.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline-alkali soil. A soil that contains a harmful concentration of salts and exchangeable sodium; contains harmful salts and is strongly alkaline; or contains harmful salts and exchangeable sodium and is very strongly alkaline. The salts, exchangeable sodium, and alkaline reaction are in the soil in such location that growth of most crop plants is less than normal.

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.

Saprolite (geology). Soft, earthy, clay-rich, thoroughly decomposed rock formed in place by chemical weathering of igneous and metamorphic rock. In soil survey, the term saprolite is applied to any unconsolidated residual material underlying the soil and grading to hard bedrock below.

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. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon.

Series, soil. A group of soils, formed from a particular type of parent material, having horizons that, except for the texture of the A or surface horizon, are similar in all profile characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

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. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silica-alumina ratio. The molecular ratio of silica to alumina in soil, clay, or any alumino-silicate mineral.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Sinkhole. A depression in a landscape where limestone has been locally dissolved.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slick spot. Locally, a small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake. The slow movement of water into the soil.

Slow refill. The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones. Rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Small stones adversely affect the specified use.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of Na^+ to $Ca^{++} + Mg^{++}$. The degrees of sodicity are—

	SAR
Slight	Less than 13:1
Moderate	13-30:1
Strong	More than 30:1

Soil. A natural, three-dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *very coarse sand* (2.0 millimeters to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter).

Solodized soil. A formerly alkali (sodic) soil that has been leached so that it has become acid and has a thick, gray upper layer over an acid, blocky B horizon. The resulting soil may be termed a Soloth.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature 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 other plant and animal life characteristics of the soil are largely confined to the solum.

Stone line. A concentration of coarse fragments in soils that generally marks an old weathering surface. In a cross section, the line may be one fragment or more thick. The line generally overlies material that weathered in place and marks the top of a paleosol. It is ordinarily overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *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* (each grain by itself, as in dune sand) or *massive* (the particles adhearing without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil, or partly worked into the soil, to provide protection from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitaion is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface soil. 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 or management.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by 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*, *silt loam*, *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. Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Trace elements. The chemical elements in soils, in only extremely small amounts, essential to plant growth. Examples are zinc, cobalt, manganese, copper, and iron.

Tuff. A compacted deposit 50 percent or more volcanic ash and dust.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Unstable fill. Risk of caving or sloughing in banks of fill material.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited by heavily loaded streams emerging from hills or mountains and spreading sediments onto the lowland as a series of adjacent alluvial fans.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but the limited geographic soil area does not justify creation of a new series.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to a soil or soil material consisting of particles well distributed over a wide range in size or diameter. Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

ILLUSTRATIONS

Figure 1.—An area of Pits. Limestone is quarried for masonry, agricultural lime, and road construction.

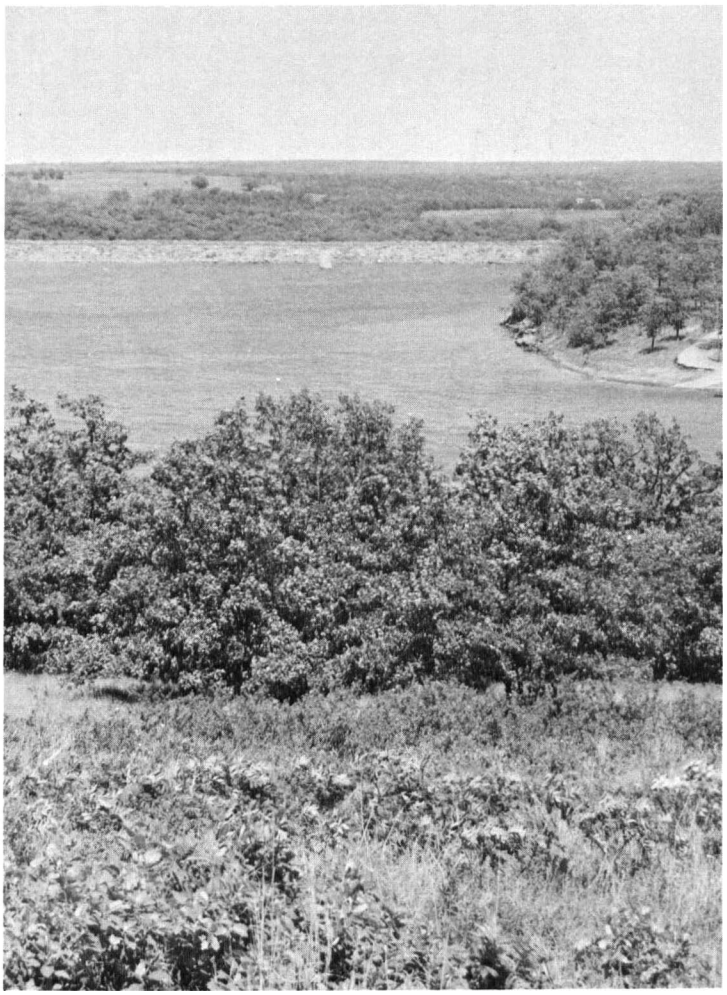


Figure 2.—Lake Bluestem, a multipurpose lake near Pawhuska. Soils are in the Niotaze-Darnell complex, 3 to 15 percent slopes.

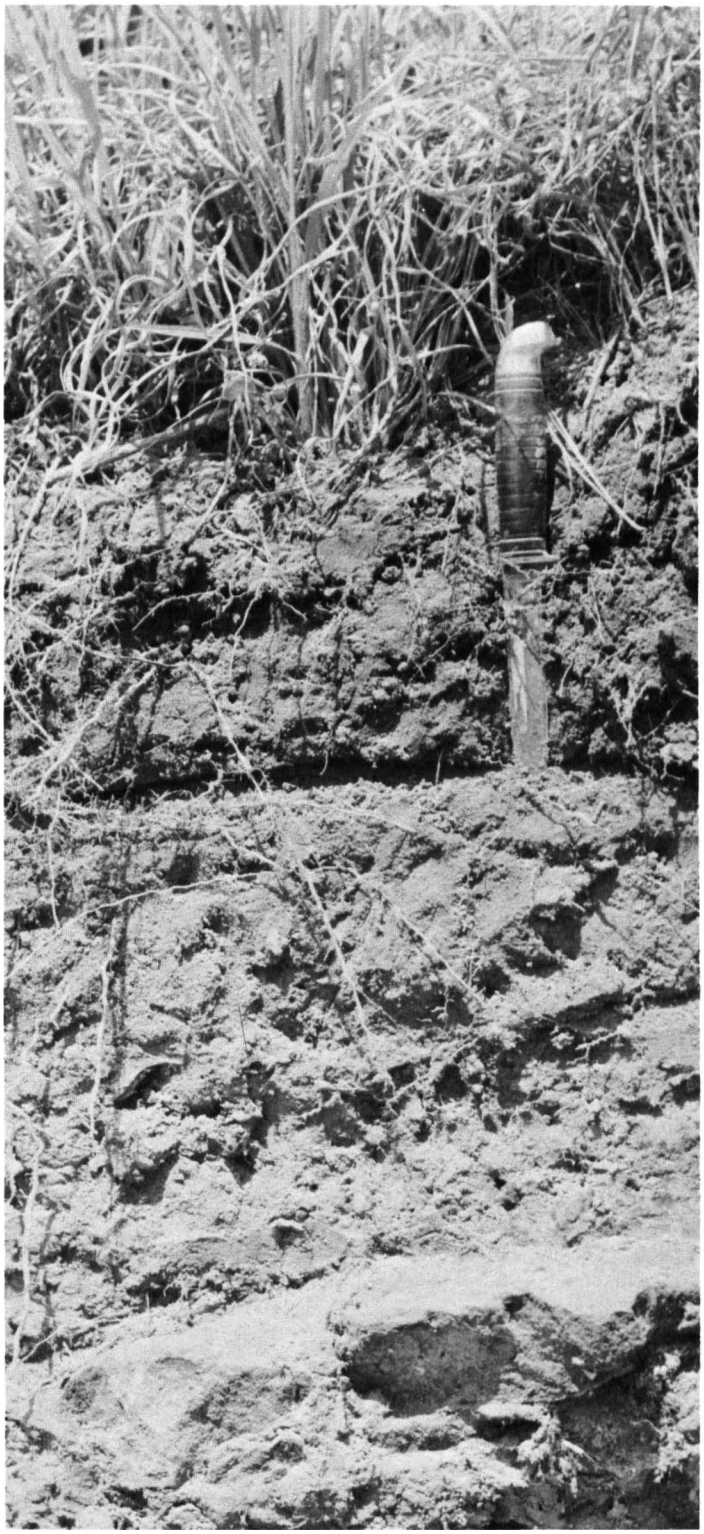


Figure 3.—Profile of Darnell fine sandy loam in an area of the Darnell-Stephenville complex, 1 to 8 percent slopes.

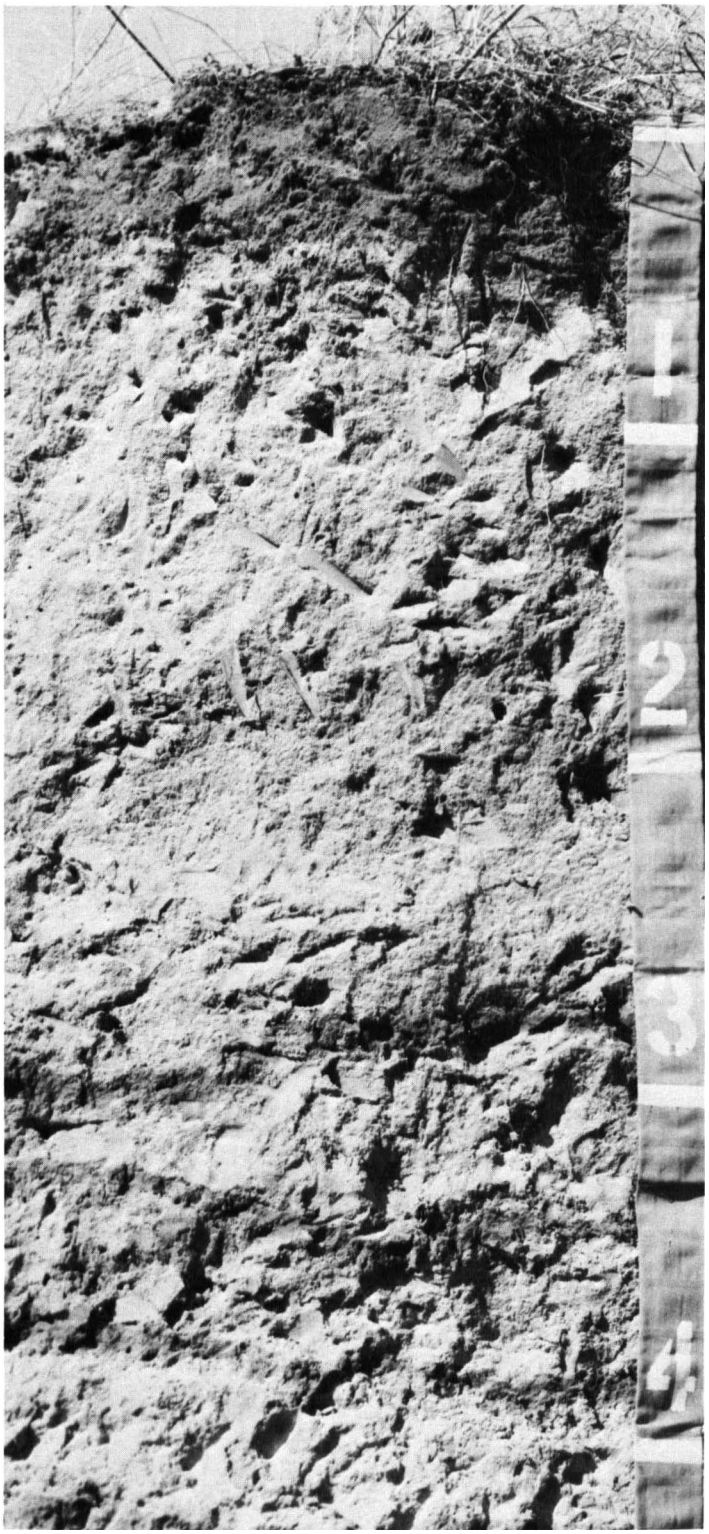


Figure 4—Profile of Eufaula loamy fine sand, 3 to 15 percent slopes. Horizontal bands at about 3 feet mark upper boundary of subsoil.

Figure 5.—An area of Mason-Drummond complex, 0 to 1 percent slopes. Mason soils support the tall grasses; Drummond soils support the short grasses.

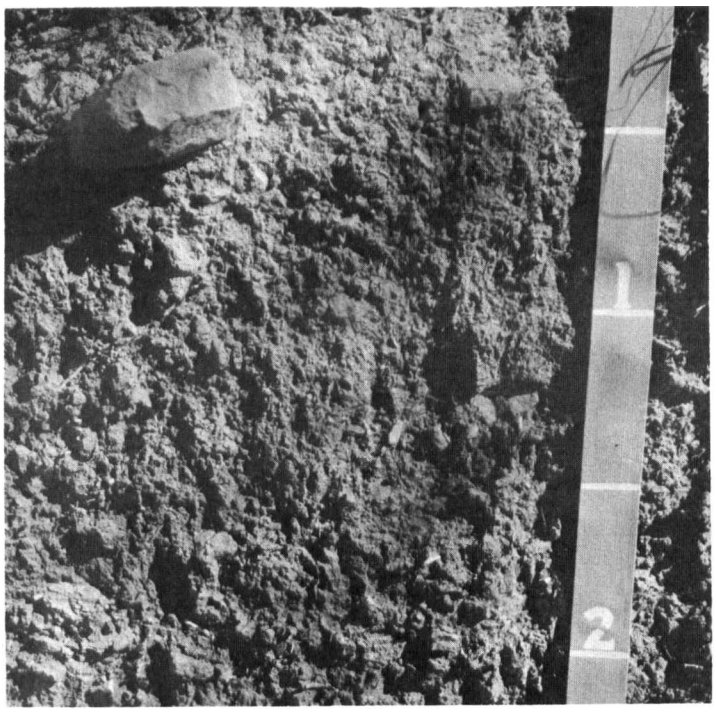


Figure 6.—Profile of Niotaze silt loam in an area of Niotaze-Darnell complex, 3 to 15 percent slopes.

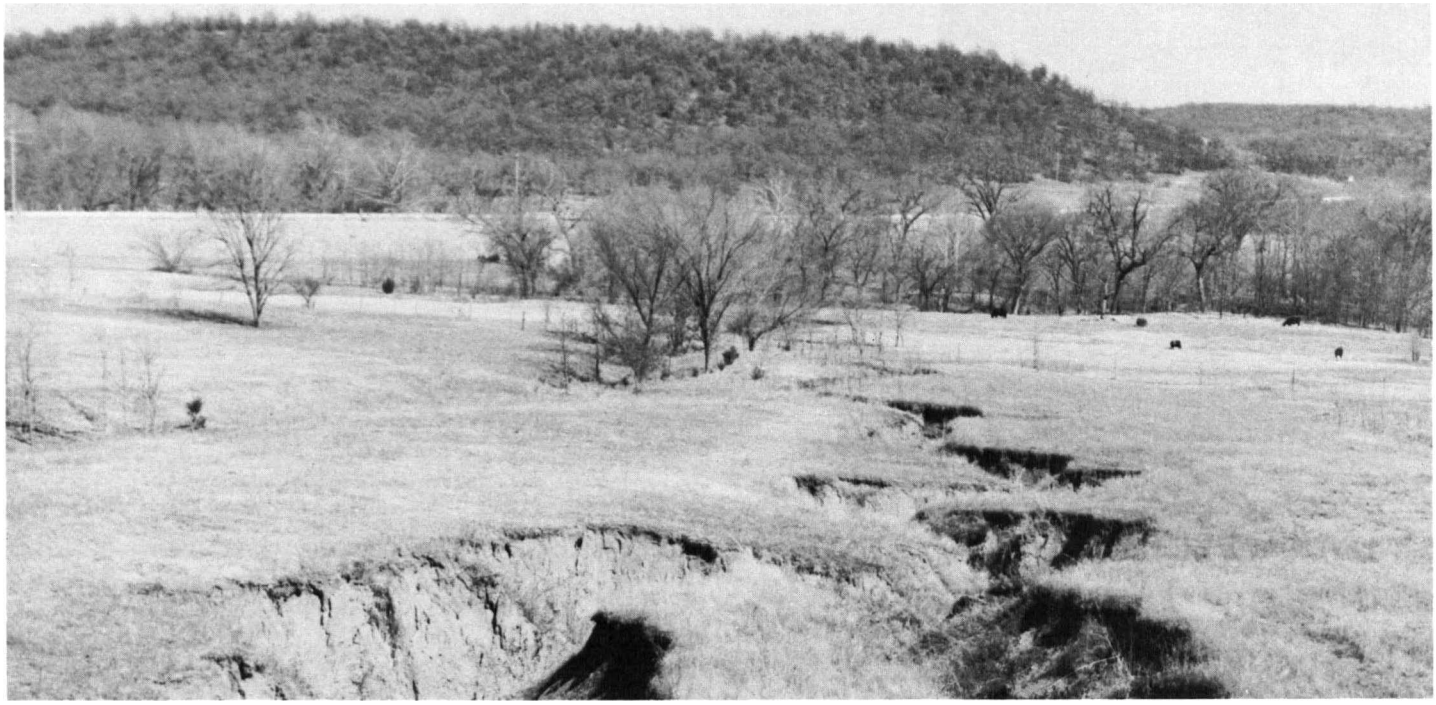


Figure 7.—Area of Norge, Dennis, and Prue soils, gullied.

Figure 8.—Profile of Shidler silty clay loam in an area of Shidler soils, 1 to 5 percent slopes.

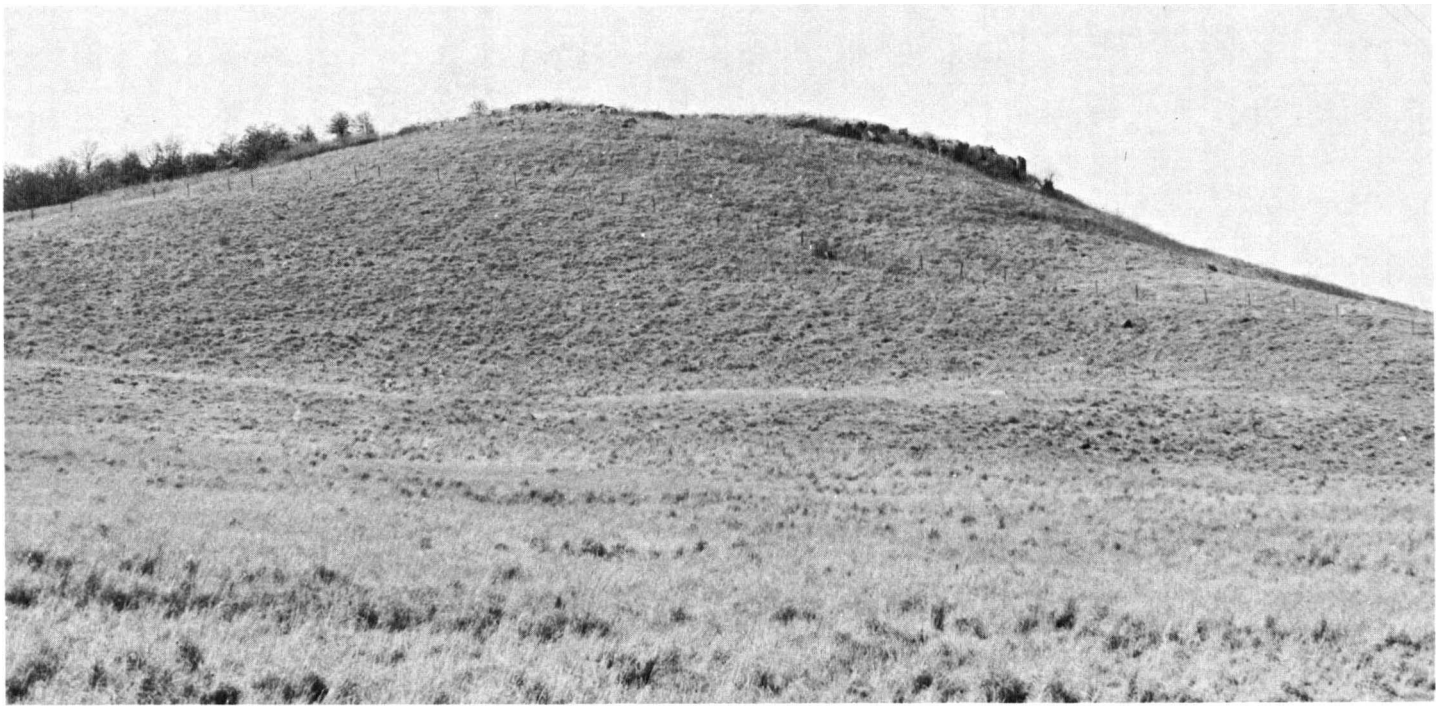


Figure 9.—Area of Steedman-Coweta complex, 15 to 25 percent slopes. Steedman silt loam is in steeper areas; Coweta loam is on ridge crests and in contour bands on side slopes.

Figure 10.—A fireguard of adequate width protects wildlife, forage, and habitat. Soils are in Stephenville-Darnell complex, 1 to 5 percent slopes.

Figure 11.—Profile of Summit silty clay loam, 3 to 5 percent slopes.

FORAGE CALENDAR
(percentage of use)

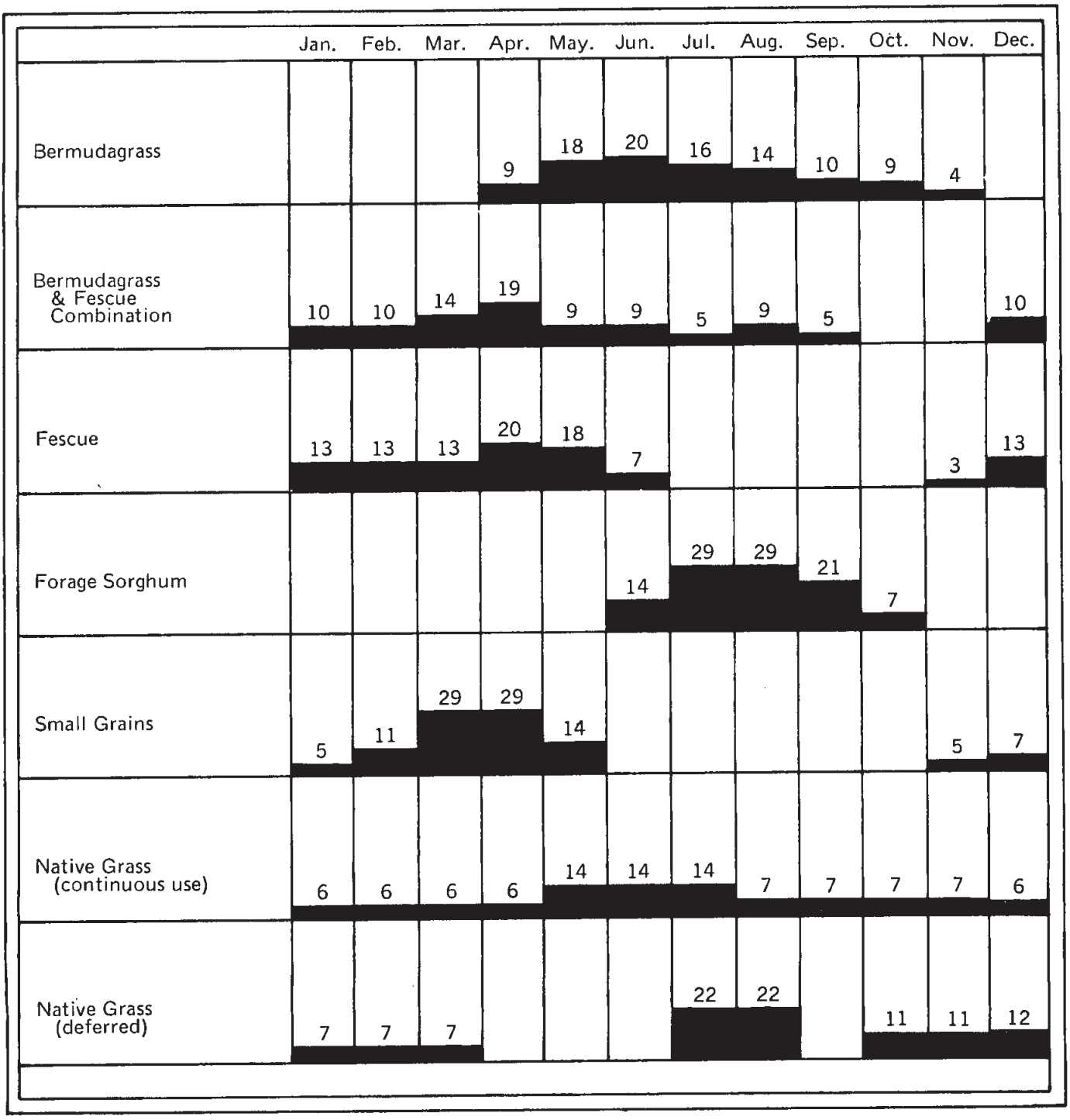


Figure 12.—Forage calendar.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION DATA

[Data from Pawhuska, Oklahoma. Period of record 1951-74]

Month	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily maximum	Average daily minimum	Average	Maximum above---	Minimum below---	Average growing degree days[1]	Average	Less than--	More than--	Average number of days with 0.10 inch or more	Average snowfall
	F	F	F	F	F	Units	In	In	In		In
January----	47.8	22.9	35.4	73	-2	0	0.99	0.42	1.45	2	2.3
February---	53.6	27.7	40.7	78	4	17	1.22	0.57	1.75	3	2.6
March------	61.4	35.3	48.4	88	10	139	2.63	1.01	3.96	5	1.9
April------	73.4	47.5	60.5	94	23	328	3.00	1.68	4.06	5	.1
May--------	80.2	56.3	68.3	93	33	567	4.44	2.42	6.09	7	0
June-------	87.7	65.2	76.5	99	47	795	4.34	2.12	6.16	6	0
July-------	93.5	69.6	81.5	105	52	977	3.60	0.84	5.76	5	0
August-----	93.2	67.4	80.4	105	52	942	3.24	1.38	4.75	4	0
September--	85.1	59.5	72.3	100	38	669	4.50	1.98	6.55	5	0
October----	75.1	48.1	61.6	93	27	367	3.19	0.98	4.96	4	0
November---	60.7	35.4	48.1	81	12	81	1.90	0.35	3.10	3	.9
December---	50.3	26.9	38.6	74	-1	15	1.49	0.63	2.17	3	2.4
Year-----	71.8	46.8	59.4	107	-5	4,897	34.54	26.28	42.27	52	10.2

[1]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Data from Pawhuska, Oklahoma. Period of record 1951-74]

Probability	Temperature		
	24 F or lower	28 F or lower	32 F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 7	April 17	April 30
2 years in 10 later than--	April 2	April 12	April 25
5 years in 10 later than--	March 23	April 3	April 16
First freezing temperature in fall:			
1 year in 10 earlier than--	October 25	October 21	October 8
2 years in 10 earlier than--	October 31	October 26	October 12
5 years in 10 earlier than--	November 11	November 3	October 21

TABLE 3.--GROWING SEASON LENGTH

[Data from Pawhuska, Oklahoma. Period of record 1951-74]

Probability	Daily minimum temperature during growing season		
	Higher than 24 F	Higher than 28 F	Higher than 32 F
	Days	Days	Days
9 years in 10	207	193	172
8 years in 10	216	200	177
5 years in 10	232	213	188
2 years in 10	248	226	199
1 year in 10	257	233	205

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1	Apperson silty clay loam, 1 to 3 percent slopes	9,292	0.6
2	Apperson-Dwight complex, 0 to 3 percent slopes	27,424	1.9
3	Barnsdall very fine sandy loam	6,109	0.4
4	Bates loam, 1 to 3 percent slopes	16,664	1.1
5	Bates loam, 3 to 5 percent slopes	1,099	0.1
6	Catoosa-Shidler complex, 1 to 3 percent slopes	8,609	0.6
7	Choska very fine sandy loam	2,061	0.1
8	Cleora fine sandy loam	5,081	0.3
9	Cleora fine sandy loam, undulating	2,212	0.1
10	Corbin silt loam, 1 to 3 percent slopes	1,902	0.1
11	Corbin silt loam, 3 to 5 percent slopes	5,219	0.4
12	Corbin-Pawhuska complex, 1 to 5 percent slopes	24,256	1.6
13	Coweta-Bates complex, 1 to 8 percent slopes	83,406	5.7
14	Darnell-Stephenville complex, 1 to 8 percent slopes	179,410	12.2
15	Dennis silt loam, 1 to 3 percent slopes	17,528	1.2
16	Dennis silt loam, 3 to 5 percent slopes	3,252	0.2
17	Dennis-Carytown complex, 1 to 5 percent slopes	43,981	3.0
18	Dennis-Verdigris complex, 0 to 12 percent slopes	29,629	2.0
19	Dougherty loamy fine sand, 1 to 3 percent slopes	8,192	0.6
20	Dougherty loamy fine sand, 3 to 8 percent slopes	9,879	0.7
21	Eufaula loamy fine sand, 3 to 15 percent slopes	15,048	1.0
22	Eufaula-Dougherty complex, 0 to 3 percent slopes	5,684	0.4
23	Foraker-Shidler complex, 12 to 25 percent slopes	31,798	2.2
24	Gasil fine sandy loam, 3 to 5 percent slopes	1,532	0.1
25	Grainola-Shidler complex, 12 to 25 percent slopes	25,298	1.7
26	Kiomatia loamy fine sand	3,811	0.3
27	Kiomatia soils	5,212	0.4
28	Konawa loamy fine sand, 3 to 8 percent slopes, eroded	1,864	0.1
29	Lightning silt loam	3,488	0.2
30	Lula silt loam, 1 to 3 percent slopes	6,157	0.4
31	Mason silt loam, 0 to 1 percent slopes	26,382	1.8
32	Mason silt loam, 1 to 3 percent slopes	4,237	0.3
33	Mason-Drummond complex, 0 to 1 percent slopes	4,643	0.3
34	Minco silt loam, 5 to 8 percent slopes	1,136	0.1
35	Niotaze-Darnell complex, 3 to 15 percent slopes	143,858	9.7
36	Niotaze-Darnell complex, 15 to 25 percent slopes	70,755	4.8
37	Niotaze-Darnell complex, 25 to 45 percent slopes	10,305	0.7
38	Norge silt loam, 1 to 3 percent slopes	6,325	0.4
39	Norge silt loam, 3 to 5 percent slopes	11,293	0.8
40	Norge silt loam, 5 to 8 percent slopes	1,346	0.1
41	Norge silt loam, 2 to 5 percent slopes, eroded	5,512	0.4
42	Norge, Dennis, and Prue soils, gullied	1,957	0.1
43	Norge-Pawhuska complex, 1 to 5 percent slopes	17,120	1.2
44	Oil-waste land	1,927	0.1
45	Okemah silt loam, 0 to 2 percent slopes	3,087	0.2
46	Osage silty clay	7,996	0.5
47	Parsons silt loam, 0 to 1 percent slopes	4,099	0.3
48	Parsons silt loam, 1 to 3 percent slopes	11,029	0.8
49	Parsons-Carytown complex, 0 to 3 percent slopes	22,009	1.5
50	Pits	564	(1)
51	Prue loam, 3 to 5 percent slopes	12,216	0.8
52	Pursley Variant fine sandy loam	1,950	0.1
53	Roebuck silty clay loam	2,869	0.2
54	Shidler soils, 1 to 5 percent slopes	31,649	2.1
55	Steedman silt loam, 1 to 3 percent slopes	7,677	0.5
56	Steedman silt loam, 3 to 5 percent slopes	3,266	0.2
57	Steedman-Coweta complex, 3 to 15 percent slopes	118,387	8.0
58	Steedman-Coweta complex, 15 to 25 percent slopes	32,058	2.2
59	Stephenville-Darnell complex, 1 to 5 percent slopes	46,923	3.2
60	Stoneburg-Lucien complex, 3 to 12 percent slopes	12,206	0.8
61	Summit silty clay loam, 3 to 5 percent slopes	5,598	0.4
62	Summit-Shidler complex, 3 to 12 percent slopes	99,772	6.8
63	Teller loam, 3 to 5 percent slopes	1,168	0.1
64	Vanoss silt loam, 0 to 1 percent slopes	860	0.1
65	Vanoss silt loam, 1 to 3 percent slopes	3,127	0.2
66	Verdigris silt loam	34,728	2.4
67	Verdigris soils	55,123	3.7
68	Wolco silty clay loam, 1 to 3 percent slopes	6,242	0.4
69	Wolco-Dwight complex, 0 to 3 percent slopes	20,844	1.4
70	Wynona silty clay loam	16,932	1.1

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
	Water	22,208	1.5
	Total	1,476,480	100.0

[1]Less than 0.1 percent.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[All yields were estimated for a high level of management in 1975. Absence of a yield figure indicates the crop is seldom grown or is not suited]

Soil name and map symbol	Alfalfa hay	Grain sorghum	Peanuts	Wheat	Improved bermuda-grass	Corn	Soybeans
	Ton	Bu	Lb	Bu	AUM[1]	Bu	Bu
Apperson:							
1	3.5	65	---	35	6.0	60	30
2[2]	---	50	---	25	5.0	---	---
Barnsdall:							
3	4.5	65	1,700	40	8.0	65	30
Bates:							
4	3.0	55	---	30	6.0	---	25
5	---	50	---	25	5.5	---	20
Catoosa:							
6[2]	---	---	---	---	3.0	---	---
Choska:							
7	4.5	70	1,500	40	8.5	60	30
Cleora:							
8, 9	4.2	65	1,500	35	7.5	55	25
Corbin:							
10	3.0	65	---	35	7.0	60	30
11	---	55	---	30	6.5	55	25
12[2]	---	50	---	25	6.0	---	20
Coweta:							
13[2]	---	---	---	---	4.5	---	---
Darnell:							
14[2]	---	---	---	---	4.5	---	---
Dennis:							
15	4.0	70	---	40	7.0	60	35
16	---	65	---	35	6.5	55	30
17[2]	---	50	---	25	5.0	---	20
18[2]	---	---	---	---	7.0	---	---
Dougherty:							
19	---	30	1,300	20	6.0	---	---
20	---	25	1,100	15	5.5	---	---
Eufaula:							
21	---	---	---	---	5.0	---	---
22[2]	---	25	1,100	15	5.5	---	---
Foraker:							
23[2]	---	---	---	---	---	---	---
Gasil:							
24	---	50	1,500	25	6.0	---	---
Grainola:							
25[2]	---	---	---	---	---	---	---
Kiomatia:							
26	3.0	40	1,300	30	7.0	40	25

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Alfalfa hay	Grain sorghum	Peanuts	Wheat	Improved bermuda-grass	Corn	Soybeans
	Ton	Bu	Lb	Bu	AUM[1]	Bu	Bu
Kiomatia:							
227	---	---	---	---	5.5	---	---
Konawa:							
28	---	30	1,300	25	5.5	---	---
Lightning:							
29	---	50	---	35	6.0	45	30
Lula:							
30	3.0	65	---	40	6.5	60	30
Mason:							
31	5.0	75	---	40	8.5	75	35
32	4.5	70	---	35	8.0	70	30
233	3.5	50	---	25	6.5	---	25
Minco:							
34	---	---	---	25	6.0	---	---
Niotaze:							
235	---	---	---	---	---	---	---
236	---	---	---	---	---	---	---
237	---	---	---	---	---	---	---
Norge:							
38	3.0	60	---	35	7.5	60	30
39	---	55	---	30	7.0	55	25
40	---	---	---	25	6.5	---	---
41	---	45	---	25	6.5	---	20
242	---	---	---	---	5.0	---	---
243	---	---	---	25	5.5	---	20
Oil-waste land:							
44	---	---	---	---	---	---	---
Okemah:							
45	4.0	70	---	40	7.5	60	35
Osage:							
46	4.0	60	---	30	6.5	60	30
Parsons:							
47	---	50	---	35	6.0	50	30
48	---	50	---	35	6.0	50	25
249	---	40	---	25	5.0	---	20
Pits:							
50	---	---	---	---	---	---	---
Prue:							
51	---	55	---	30	6.5	50	20
Pursley Variant:							
52	4.0	65	1,500	30	8.5	55	25
Roebuck:							
53	4.5	60	---	30	7.0	60	30

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Alfalfa hay	Grain sorghum	Peanuts	Wheat	Improved bermuda-grass	Corn	Soybeans
	Ton	Bu	Lb	Bu	AUM[1]	Bu	Bu
Shidler:							
54	---	---	---	---	---	---	---
Steedman:							
55	---	35	---	30	5.5	---	---
56	---	30	---	25	5.0	---	---
[2]57	---	---	---	---	---	---	---
[2]58	---	---	---	---	---	---	---
Stephenville:							
[2]59	---	30	---	25	5.5	---	---
Stoneburg:							
[2]60	---	---	---	---	4.0	---	---
Summit:							
61	---	60	---	35	6.5	55	30
[2]62	---	---	---	---	4.0	---	---
Teller:							
63	---	55	1,300	30	7.0	50	25
Vanoss:							
64	3.5	70	1,700	40	8.0	65	35
65	3.0	60	1,500	35	7.5	60	30
Verdigris:							
66	4.5	70	---	40	8.5	70	35
[2]67	---	---	---	---	7.5	---	---
Wolco:							
68	3.0	50	---	30	6.5	---	25
[2]69	2.5	46	---	25	6.0	---	20
Wynona:							
70	5.0	70	---	40	7.5	65	35

[1]Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for a period of 30 days.

[2]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 6.--GRAZING YIELDS PER ACRE

[All yields were estimated for a high level of management in 1974. Absence of a yield figure indicates that the crop or pasture grass is seldom grown or is not suited]

Soil name and map symbol	Improved bermudagrass	Fescue-bermudagrass	Fescue	Small grains	Forage sorghum
	AUM[1]	AUM[1]	AUM[1]	AUM[1]	AUM[1]
Apperson:					
1	6.0	6.0	6.0	4.2	4.5
2 2	5.0	4.5	4.0	4.0	3.0
Barnsdall:					
3	8.0	7.0	6.0	4.7	4.5
Bates:					
4	6.0	5.5	5.0	4.2	4.3
5	5.5	5.0	4.5	4.0	4.0
Catoosa:					
2 6	3.0	---	---	---	---
Choska:					
7	8.5	8.5	6.5	4.7	6.0
Cleora:					
8	8.0	8.0	6.0	4.3	6.0
9	7.5	7.5	6.0	4.3	6.0
Corbin:					
10	7.0	6.5	6.0	4.3	4.0
11	6.5	6.0	5.5	4.0	4.0
12	6.0	5.0	4.0	3.0	3.0
Coweta:					
2 13	4.5	---	---	---	---
Darnell:					
2 14	4.5	---	---	---	---
Dennis:					
15	7.0	7.0	6.0	4.5	5.1
16	6.5	6.0	5.5	4.3	4.8
2 17	5.0	4.5	4.0	3.5	4.0
2 18	7.0	7.0	6.0	---	---
Dougherty:					
19	6.0	---	---	3.7	4.5
20	5.5	---	---	3.0	3.7
Eufaula:					
21	5.0	---	---	---	---
2 22	5.5	---	---	3.0	3.5
Foraker:					
2 23	---	---	---	---	---
Gasil:					
24	6.0	---	---	3.7	4.0
Grainola:					
2 25	---	---	---	---	---

See footnotes at end of table.

TABLE 6.--GRAZING YIELDS PER ACRE--Continued

Soil name and map symbol	Improved bermudagrass	Fescue-bermudagrass	Fescue	Small grains	Forage sorghum
	AUM[1]	AUM[1]	AUM[1]	AUM[1]	AUM[1]
Kiomatia:					
26	7.0	---	---	4.0	5.5
27	5.5	---	---	---	---
Konawa:					
28	5.5	---	---	---	---
Lightning:					
29	6.0	6.5	6.5	4.7	3.5
Lula:					
30	6.5	6.5	5.5	4.5	4.8
Mason:					
31	8.5	8.5	7.5	4.7	6.0
32	8.0	8.0	7.0	4.5	5.8
[2]33	6.5	6.0	5.5	4.0	4.5
Minco:					
34	6.0	---	---	3.5	4.5
Niotaze:					
[2]35	---	---	---	---	---
[2]36	---	---	---	---	---
[2]37	---	---	---	---	---
Norge:					
38	7.5	7.5	6.5	4.5	5.5
39	7.0	7.0	6.0	4.0	5.0
40	6.5	---	---	3.5	4.5
41	6.5	---	---	3.5	4.5
[2]42	5.0	---	---	---	---
[2]43	5.5	---	---	3.0	3.5
Oil-waste land:					
44	---	---	---	---	---
Okemah:					
45	7.5	7.5	7.0	4.7	5.7
Osage:					
46	6.5	---	7.5	4.0	---
Parsons:					
47	6.0	6.0	6.0	4.3	4.5
48	6.0	5.5	5.0	4.0	4.0
[2]49	5.0	5.0	5.0	4.0	3.0
Pits:					
50	---	---	---	---	---
Prue:					
51	6.5	6.0	5.0	3.7	4.0
Pursley Variant:					
52	8.5	8.5	8.5	4.7	6.0

See footnotes at end of table.

TABLE 6.--GRAZING YIELDS PER ACRE--Continued

Soil name and map symbol	Improved bermudagrass	Fescue-bermudagrass	Fescue	Small grains	Forage sorghum
	AUM[1]	AUM[1]	AUM[1]	AUM[1]	AUM[1]
Roebuck:					
53	7.0	7.0	7.0	4.5	4.5
Shidler:					
54	---	---	---	---	---
Steedman:					
55	5.5	5.0	4.0	3.0	4.0
56	5.0	---	---	3.0	---
[2]57	---	---	---	---	---
[2]58	---	---	---	---	---
Stephenville:					
[2]59	5.5	---	---	---	---
Stoneburg:					
[2]60	4.0	---	---	---	---
Summit:					
61	6.5	6.5	5.5	4.0	4.0
[2]62	4.0	---	---	---	---
Teller:					
63	7.0	7.0	6.0	4.0	5.1
Vanoss:					
64	8.0	8.0	7.0	4.7	5.8
65	7.5	7.5	6.5	4.5	5.5
Verdigris:					
66	8.5	8.5	8.5	4.7	6.0
67	7.5	7.5	7.5	---	---
Wolco:					
68	6.5	6.5	6.0	4.2	4.0
[2]69	6.0	6.0	5.5	3.0	3.0
Wynona:					
70	7.5	8.5	8.5	4.5	5.7

[1]AUM is Animal-Unit-Month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for a period of 30 days.

[2]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the behavior and composition of the whole mapping unit.

TABLE 7.--RANGE PRODUCTIVITY AND COMPOSITION

[Soils not listed are not in range sites; such soils can be used for grazing if grass cover is established]

Soil name and map symbol	Range site	Total production		Common plant name	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
Apperson:					
1	Loamy Prairie	Favorable	6,000	Big bluestem	35
		Normal	4,300	Little bluestem	15
		Unfavorable	3,200	Switchgrass	10
				Indiangrass	10
				Scribner panicum	5
				Other perennial grasses	18
				Other perennial forbs	5
				Other shrubs	2
[1]2:					
Apperson part	Loamy Prairie	Favorable	6,000	Big bluestem	35
		Normal	4,300	Little bluestem	15
		Unfavorable	3,200	Switchgrass	10
				Indiangrass	10
				Scribner panicum	5
				Other perennial grasses	18
				Other perennial forbs	5
				Other shrubs	2
Dwight part	Shallow Claypan	Favorable	4,000	Little bluestem	20
		Normal	3,000	Big bluestem	15
		Unfavorable	2,000	Prairie dropseed	10
				Western wheatgrass	10
				Switchgrass	5
				Sideoats grama	5
				Buffalograss	2
				Other perennial grasses	28
				Other perennial forbs	5
Barnsdall:					
3	Loamy Bottomland	Favorable	10,000	Switchgrass	25
		Normal	8,800	Indiangrass	20
		Unfavorable	8,000	Big bluestem	15
				Little bluestem	10
				Eastern gamagrass	5
				Sedge	5
				Compassplant	5
				Other perennial grasses	10
				Other trees	5
Bates:					
4, 5	Loamy Prairie	Favorable	7,000	Little bluestem	40
		Normal	5,500	Big bluestem	20
		Unfavorable	4,500	Indiangrass	10
				Switchgrass	5
				Leadplant	5
				Other perennial grasses	15
				Other perennial forbs	3
				Other shrubs	2
Catoosa:					
[1]6:					
Catoosa part	Loamy Prairie	Favorable	6,500	Little bluestem	25
		Normal	5,000	Big bluestem	25
		Unfavorable	4,000	Indiangrass	10
				Switchgrass	5
				Other perennial grasses	25
				Other perennial forbs	5
				Other shrubs	5

See footnote at end of table.

TABLE 7.--RANGE PRODUCTIVITY AND COMPOSITION--Continued

Soil name and map symbol	Range site	Total production		Common plant name	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
Catoosa:					
Shidler part-----	Very Shallow----------	Favorable	2,500	Sideoats grama----------	30
		Normal	1,300	Little bluestem----------	25
		Unfavorable	500	Other perennial grasses--------	33
				Other perennial forbs---------	10
				Other shrubs----------	2
Choska:					
7----------	Loamy Bottomland----------	Favorable	9,000	Switchgrass----------	15
		Normal	7,200	Eastern gamagrass----------	10
		Unfavorable	6,000	Sedge----------	5
				Virginia wildrye----------	5
				Broadleaf uniola----------	5
				Little bluestem----------	5
				Beaked panicum----------	5
				Indiangrass----------	5
				Other trees----------	15
				Other perennial grasses--------	15
				Other perennial forbs---------	5
				Other shrubs----------	5
Cleora:					
8, 9----------	Loamy Bottomland----------	Favorable	8,500	Switchgrass----------	15
		Normal	6,100	Big bluestem----------	10
		Unfavorable	4,500	Little bluestem----------	10
				Sedge----------	5
				Virginia wildrye----------	5
				Broadleaf uniola----------	5
				Beaked panicum----------	5
				Indiangrass----------	5
				Other trees----------	15
				Other perennial grasses--------	15
				Other perennial forbs---------	5
				Other shrubs----------	5
Corbin:					
10, 11----------	Loamy Prairie----------	Favorable	6,000	Big bluestem----------	30
		Normal	4,000	Little bluestem----------	20
		Unfavorable	2,000	Indiangrass----------	10
				Switchgrass----------	10
				Other perennial grasses--------	25
				Other perennial forbs---------	5
[1]12:					
Corbin part------	Loamy Prairie----------	Favorable	6,000	Big bluestem----------	30
		Normal	4,000	Little bluestem----------	20
		Unfavorable	2,000	Indiangrass----------	10
				Switchgrass----------	10
				Other perennial grasses--------	25
				Other perennial forbs---------	5
Pawhuska part----	Shallow Claypan----------	Favorable	3,000	Little bluestem----------	25
		Normal	2.100	Indiangrass----------	10
		Unfavorable	1,500	Sideoats grama----------	10
				Big bluestem----------	10
				Switchgrass----------	5
				Other perennial grasses--------	35
				Other perennial forbs---------	5
Coweta:					
[1]13:					
Coweta part------	Shallow Prairie----------	Favorable	3,500	Little bluestem----------	30
		Normal	2,300	Big bluestem----------	15
		Unfavorable	1,500	Indiangrass----------	10
				Switchgrass----------	10
				Tall dropseed----------	5
				Other perennial grasses--------	22
				Other perennial forbs---------	5
				Other shrubs----------	3

See footnote at end of table.

TABLE 7.--RANGE PRODUCTIVITY AND COMPOSITION--Continued

Soil name and map symbol	Range site	Total production		Common plant name	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
Coweta:					
[1]13:					
Bates part	Loamy Prairie	Favorable	7,000	Little bluestem	40
		Normal	5,500	Big bluestem	20
		Unfavorable	4,500	Indiangrass	10
				Switchgrass	5
				Leadplant	5
				Other perennial grasses	15
				Other perennial forbs	3
				Other shrubs	2
Darnell:					
[1]14:					
Darnell part	Shallow Savannah	Favorable	3,200	Little bluestem	30
		Normal	2,100	Big bluestem	20
		Unfavorable	1,400	Hairy sunflower	5
				Other perennial grasses	25
				Other trees	10
				Other shrubs	10
Stephenville part	Sandy Savannah	Favorable	4,500	Little bluestem	25
		Normal	3,300	Big bluestem	20
		Unfavorable	2,500	Indiangrass	5
				Other trees	20
				Other perennial grasses	20
				Other perennial forbs	5
				Other shrubs	5
Dennis:					
15, 16	Loamy Prairie	Favorable	7,000	Little bluestem	30
		Normal	5,500	Big bluestem	20
		Unfavorable	4,500	Switchgrass	10
				Indiangrass	10
				Other perennial grasses	23
				Other perennial forbs	5
				Other shrubs	2
[1]17:					
Dennis part	Loamy Prairie	Favorable	7,000	Little bluestem	30
		Normal	5,500	Big bluestem	20
		Unfavorable	4,500	Switchgrass	10
				Indiangrass	10
				Other perennial grasses	23
				Other perennial forbs	5
				Other shrubs	2
Carytown part	Shallow Claypan	Favorable	4,000	Little bluestem	20
		Normal	3,000	Big bluestem	15
		Unfavorable	2,000	Switchgrass	15
				Prairie dropseed	5
				Other perennial grasses	38
				Other perennial forbs	5
				Other shrubs	2
[1]18:					
Dennis part	Loamy Prairie	Favorable	7,000	Little bluestem	30
		Normal	5,500	Big bluestem	20
		Unfavorable	4,500	Switchgrass	10
				Indiangrass	10
				Other perennial grasses	23
				Other perennial forbs	5
				Other shrubs	2

See footnote at end of table.

TABLE 7.--RANGE PRODUCTIVITY AND COMPOSITION--Continued

Soil name and map symbol	Range site	Total production		Common plant name	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
Dennis:					
[1]18:					
Verdigris part---	Loamy Bottomland----------	Favorable	10,000	Big bluestem----------	40
		Normal	8,500	Indiangrass----------	20
		Unfavorable	6,000	Switchgrass----------	10
				Eastern gamagrass----------	8
				Little bluestem----------	5
				Prairie cordgrass----------	3
				Maximilian sunflower----------	3
				Wholeleaf rosinweed----------	2
				Tall dropseed----------	1
				Sedge----------	1
				Coralberry----------	1
				Canada goldenrod----------	1
				Other trees----------	5
Dougherty:					
19, 20----------	Deep Sand Savannah----------	Favorable	4,000	Little bluestem----------	25
		Normal	2,800	Big bluestem----------	20
		Unfavorable	2,000	Switchgrass----------	5
				Indiangrass----------	5
				Other perennial grasses--------	20
				Other trees----------	15
				Other perennial forbs----------	5
				Other shrubs----------	5
Eufaula:					
21----------	Deep Sand Savannah----------	Favorable	3,800	Little bluestem----------	25
		Normal	2,700	Big bluestem----------	20
		Unfavorable	2,000	Switchgrass----------	5
				Indiangrass----------	5
				Other trees----------	20
				Other perennial grasses--------	15
				Other shrubs----------	5
				Other perennial forbs----------	5
[1]22:					
Eufaula part-----	Deep Sand Savannah----------	Favorable	3,800	Little bluestem----------	25
		Normal	2,700	Big bluestem----------	20
		Unfavorable	2,000	Switchgrass----------	5
				Indiangrass----------	5
				Other trees----------	20
				Other perennial grasses--------	15
				Other shrubs----------	5
				Other trees----------	5
Dougherty part---	Deep Sand Savannah----------	Favorable	4,000	Little bluestem----------	25
		Normal	2,800	Big bluestem----------	20
		Unfavorable	2,000	Switchgrass----------	5
				Indiangrass----------	5
				Other perennial grasses--------	20
				Other trees----------	15
				Other perennial forbs----------	5
				Other shrubs----------	5
Foraker:					
[1]23:					
Foraker part-----	Loamy Prairie----------	Favorable	6,200	Little bluestem----------	25
		Normal	4,800	Big bluestem----------	20
		Unfavorable	3,800	Indiangrass----------	10
				Switchgrass----------	5
				Canada wildrye----------	5
				Sideoats grama----------	5
				Other perennial grasses--------	23
				Other perennial forbs----------	5
				Other shrubs----------	2

See footnote at end of table.

TABLE 7.--RANGE PRODUCTIVITY AND COMPOSITION--Continued

Soil name and map symbol	Range site	Total production		Common plant name	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
Foraker:					
[1]23:					
Shidler part	Very Shallow	Favorable	2,500	Sideoats grama	30
		Normal	1,300	Little bluestem	25
		Unfavorable	500	Other perennial grasses	33
				Other perennial forbs	10
				Other shrubs	2
Gasil:					
24	Sandy Savannah	Favorable	5,000	Little bluestem	45
		Normal	3,800	Indiangrass	10
		Unfavorable	3,000	Other perennial grasses	20
				Other trees	15
				Other shrubs	5
				Other perennial forbs	5
Grainola:					
[1]25:					
Grainola part	Shallow Prairie	Favorable	4,000	Little bluestem	35
		Normal	2,800	Big bluestem	15
		Unfavorable	2,000	Indiangrass	10
				Sideoats grama	5
				Other perennial grasses	28
				Other perennial forbs	5
				Other shrubs	2
Shidler part	Very Shallow	Favorable	2,500	Sideoats grama	30
		Normal	1,300	Little bluestem	25
		Unfavorable	500	Other perennial grasses	33
				Other perennial forbs	10
				Other shrubs	2
Kiomatia:					
26, [1]27	Sandy Bottomland	Favorable	4,300	Switchgrass	25
		Normal	2,900	Big bluestem	15
		Unfavorable	2,000	Indiangrass	15
				Little bluestem	5
				Beaked panicum	5
				Purpletop	5
				Maximilian sunflower	5
				Other perennial grasses	20
				Other trees	5
Konawa:					
28	Deep Sand Savannah	Favorable	3,800	Little bluestem	25
		Normal	2,700	Big bluestem	20
		Unfavorable	1,800	Indiangrass	5
				Switchgrass	5
				Other perennial grasses	20
				Other trees	15
				Other perennial forbs	5
				Other shrubs	5
Lightning:					
29	Heavy Bottomland	Favorable	5,500	Switchgrass	30
		Normal	3,600	Indiangrass	15
		Unfavorable	3,000	Big bluestem	15
				Prairie cordgrass	10
				Eastern gamagrass	5
				Perennial sunflower	5
				Eastern cottonwood	5
				Other perennial grasses	15

See footnote at end of table.

TABLE 7.--RANGE PRODUCTIVITY AND COMPOSITION--Continued

Soil name and map symbol	Range site	Total production		Common plant name	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
Lula:					
30	Loamy Prairie	Favorable	6,800	Big bluestem	35
		Normal	5,200	Little bluestem	20
		Unfavorable	4,200	Indiangrass	10
				Switchgrass	5
				Other perennial grasses	23
				Other perennial forbs	5
				Other shrubs	2
Mason:					
31	Loamy Bottomland	Favorable	11,500	Big bluestem	25
		Normal	9,400	Indiangrass	20
		Unfavorable	8,000	Switchgrass	15
				Little bluestem	10
				Eastern gamagrass	5
				Beaked panicum	5
				Sedge	5
				Florida paspalum	5
				Compassplant	5
				Other trees	5
32	Loamy Bottomland	Favorable	11,500	Big bluestem	25
		Normal	9,400	Indiangrass	20
		Unfavorable	8,000	Switchgrass	15
				Little bluestem	10
				Eastern gamagrass	5
				Beaked panicum	5
				Sedge	5
				Florida paspalum	5
				Compassplant	5
				Other trees	5
[1]33:					
Mason part	Loamy Bottomland	Favorable	11,500	Big bluestem	25
		Normal	9,400	Indiangrass	20
		Unfavorable	8,000	Switchgrass	15
				Little bluestem	10
				Eastern gamagrass	5
				Beaked panicum	5
				Sedge	5
				Florida paspalum	5
				Compassplant	5
				Other trees	5
Drummond part	Alkali Bottomland	Favorable	3,800	Prairie cordgrass	30
		Normal	2,700	Switchgrass	10
		Unfavorable	2,000	Indiangrass	5
				Little bluestem	5
				Meadow dropseed	5
				Canada wildrye	5
				Alkali sacaton	5
				Illinois bundleflower	5
				Sedge	5
				Other perennial grasses	20
				Other shrubs	5
Minco:					
34	Loamy Prairie	Favorable	6,500	Little bluestem	25
		Normal	4,700	Big bluestem	20
		Unfavorable	3,500	Indiangrass	10
				Switchgrass	5
				Other perennial grasses	33
				Other perennial forbs	5
				Other shrubs	2

See footnote at end of table.

TABLE 7.--RANGE PRODUCTIVITY AND COMPOSITION--Continued

Soil name and map symbol	Range site	Total production		Common plant name	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
Niotaze:					
[1]35:					
Niotaze part	Sandy Savannah	Favorable	5,000	Little bluestem	25
		Normal	3,800	Big bluestem	20
		Unfavorable	3,000	Post oak	10
				Hairy sunflower	5
				Other perennial grasses	25
				Other trees	10
				Other shrubs	5
Darnell part	Shallow Savannah	Favorable	3,200	Little bluestem	30
		Normal	2,100	Big bluestem	20
		Unfavorable	1,400	Indiangrass	5
				Switchgrass	5
				Other perennial grasses	15
				Other shrubs	10
				Other trees	10
				Other perennial forbs	5
[1]36:					
Niotaze part	Sandy Savannah	Favorable	4,500	Little bluestem	25
		Normal	3,300	Big bluestem	20
		Unfavorable	2,500	Post oak	10
				Indiangrass	5
				Switchgrass	5
				Hairy sunflower	5
				Other perennial grasses	15
				Other trees	10
				Other shrubs	5
Darnell part	Shallow Savannah	Favorable	3,000	Little bluestem	30
		Normal	2,000	Big bluestem	20
		Unfavorable	1,300	Indiangrass	5
				Switchgrass	5
				Other perennial grasses	15
				Other shrubs	10
				Other trees	10
				Other perennial forbs	5
[1]37:					
Niotaze part	Savannah Breaks	Favorable	3,500	Little bluestem	30
		Normal	2,600	Big bluestem	15
		Unfavorable	2,000	Post oak	10
				Other perennial grasses	20
				Other trees	15
				Other perennial forbs	5
				Other shrubs	5
Darnell part	Savannah Breaks	Favorable	2,000	Little bluestem	35
		Normal	1,500	Big bluestem	15
		Unfavorable	700	Sideoats grama	5
				Other perennial grasses	17
				Other shrubs	10
				Other trees	10
				Other perennial forbs	8
Norge:					
38, 39, 40, 41	Loamy Prairie	Favorable	6,000	Little bluestem	25
		Normal	4,500	Big bluestem	20
		Unfavorable	3,500	Indiangrass	10
				Switchgrass	5
				Other perennial grasses	33
				Other perennial forbs	5
				Other shrubs	2

See footnote at end of table.

TABLE 7.--RANGE PRODUCTIVITY AND COMPOSITION--Continued

Soil name and map symbol	Range site	Total production		Common plant name	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
Norge:					
[1]42:					
Norge part	Eroded Prairie	Favorable	3,200	Little bluestem	35
		Normal	2,200	Big bluestem	10
		Unfavorable	1,500	Indiangrass	10
				Scribner panicum	5
				Sideoats grama	5
				Other perennial grasses	27
				Other perennial forbs	8
Dennis part	Eroded Prairie	Favorable	3,200	Little bluestem	35
		Normal	2,200	Indiangrass	10
		Unfavorable	1,500	Sideoats grama	5
				Big bluestem	5
				Scribner panicum	5
				Other perennial grasses	30
				Other perennial forbs	10
Prue part	Eroded Prairie	Favorable	3,200	Little bluestem	30
		Normal	2,200	Big bluestem	10
		Unfavorable	1,500	Indiangrass	10
				Scribner panicum	5
				Sideoats grama	5
				Other perennial grasses	30
				Other perennial forbs	10
[1]43:					
Norge part	Loamy Prairie	Favorable	6,000	Little bluestem	25
		Normal	4,500	Big bluestem	20
		Unfavorable	3,500	Indiangrass	10
				Switchgrass	5
				Other perennial grasses	33
				Other perennial forbs	5
				Other shrubs	2
Pawhuska part	Shallow Claypan	Favorable	3,000	Little bluestem	25
		Normal	2,100	Indiangrass	10
		Unfavorable	1,500	Sideoats grama	10
				Big bluestem	10
				Switchgrass	5
				Other perennial grasses	35
				Other perennial forbs	5
Oil-waste land:					
44	---	---	---	---	---
Okemah:					
45	Loamy Prairie	Favorable	7,000	Little bluestem	40
		Normal	5,500	Big bluestem	20
		Unfavorable	4,500	Indiangrass	10
				Switchgrass	5
				Catclaw sensitivebrier	5
				Other perennial grasses	18
				Other shrubs	2
Osage:					
46	Heavy Bottomland	Favorable	8,000	Switchgrass	30
		Normal	6,200	Indiangrass	15
		Unfavorable	5,000	Big bluestem	15
				Eastern gamagrass	10
				Prairie cordgrass	10
				Perennial sunflower	5
				Eastern cottonwood	5
				Other perennial grasses	10

See footnote at end of table.

TABLE 7.--RANGE PRODUCTIVITY AND COMPOSITION--Continued

Soil name and map symbol	Range site	Total production		Common plant name	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
Parsons:					
47, 48	Claypan Prairie	Favorable	4,500	Little bluestem	25
		Normal	3,000	Big bluestem	20
		Unfavorable	2,000	Switchgrass	15
				Indiangrass	10
				Other perennial grasses	25
				Other perennial forbs	5
[1]49:					
Parsons part	Claypan Prairie	Favorable	4,500	Little bluestem	25
		Normal	3,000	Big bluestem	20
		Unfavorable	2,000	Switchgrass	15
				Indiangrass	10
				Other perennial grasses	25
				Other perennial forbs	5
Carytown part	Shallow Claypan	Favorable	4,000	Little bluestem	20
		Normal	3,000	Big bluestem	15
		Unfavorable	2,000	Switchgrass	15
				Prairie dropseed	5
				Other perennial grasses	38
				Other perennial forbs	5
				Other shrubs	2
Pits:					
50	---	---	---	---	---
Prue:					
51	Loamy Prairie	Favorable	7,000	Little bluestem	30
		Normal	5,200	Big bluestem	20
		Unfavorable	4,000	Switchgrass	10
				Indiangrass	10
				Other perennial grasses	23
				Other perennial forbs	5
				Other shrubs	2
Pursley Variant:					
52	Loamy Bottomland	Favorable	8,500	Switchgrass	25
		Normal	6,100	Indiangrass	20
		Unfavorable	4,500	Big bluestem	15
				Little bluestem	10
				Compassplant	5
				Sedge	5
				Eastern gamagrass	5
				Other perennial grasses	10
				Other trees	5
Roebuck:					
53	Heavy Bottomland	Favorable	6,000	Switchgrass	20
		Normal	4,500	Big bluestem	15
		Unfavorable	3,500	Sedge	10
				Florida paspalum	5
				Prairie cordgrass	5
				Other perennial grasses	20
				Other perennial forbs	10
				Other trees	10
				Other shrubs	5
Shidler:					
[1]54	Very Shallow	Favorable	2,200	Sideoats grama	25
		Normal	1,200	Little bluestem	20
		Unfavorable	500	Hairy grama	5
				Other perennial grasses	40
				Other perennial forbs	8
				Other shrubs	2

See footnote at end of table.

TABLE 7.--RANGE PRODUCTIVITY AND COMPOSITION--Continued

Soil name and map symbol	Range site	Total production		Common plant name	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
Steedman:					
55, 56	Loamy Prairie	Favorable	6,500	Little bluestem	25
		Normal	5,000	Big bluestem	20
		Unfavorable	4,000	Indiangrass	10
				Switchgrass	5
				Other perennial grasses	33
				Other perennial forbs	5
				Other shrubs	2
[1]57:					
Steedman part	Loamy Prairie	Favorable	6,500	Little bluestem	25
		Normal	5,000	Big bluestem	20
		Unfavorable	4,000	Indiangrass	10
				Switchgrass	5
				Other perennial grasses	33
				Other perennial forbs	5
				Other shrubs	2
Coweta part	Shallow Prairie	Favorable	3,500	Little bluestem	25
		Normal	2,300	Big bluestem	15
		Unfavorable	1,500	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5
				Sideoats grama	5
				Other perennial grasses	17
				Other perennial forbs	5
				Other shrubs	3
Steedman:					
[1]58:					
Steedman part	Loamy Prairie	Favorable	6,500	Little bluestem	25
		Normal	5,000	Big bluestem	20
		Unfavorable	4,000	Indiangrass	10
				Switchgrass	5
				Other perennial grasses	33
				Other perennial forbs	5
				Other shrubs	2
Coweta part	Shallow Prairie	Favorable	3,500	Little bluestem	30
		Normal	2,300	Big bluestem	15
		Unfavorable	1,500	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5
				Sideoats grama	5
				Dotted gayfeather	5
				Other perennial grasses	17
				Other perennial forbs	5
				Other shrubs	3
Stephenville:					
[1]59:					
Stephenville part	Sandy Savannah	Favorable	4,500	Little bluestem	25
		Normal	3,300	Big bluestem	20
		Unfavorable	2,500	Indiangrass	5
				Other trees	20
				Other perennial grasses	20
				Other perennial forbs	5
				Other shrubs	5
Darnell part	Shallow Savannah	Favorable	3,200	Little bluestem	30
		Normal	2,100	Big bluestem	20
		Unfavorable	1,400	Hairy sunflower	5
				Other perennial grasses	25
				Other trees	10
				Other shrubs	10

See footnote at end of table.

TABLE 7.--RANGE PRODUCTIVITY AND COMPOSITION--Continued

Soil name and map symbol	Range site	Total production		Common plant name	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
Stoneburg:					
[1]60:					
Stoneburg part---	Loamy Prairie----------	Favorable	6,500	Little bluestem----------	30
		Normal	5,000	Indiangrass----------	20
		Unfavorable	4,000	Big bluestem----------	15
				Sideoats grama----------	10
				Other perennial grasses-------	18
				Other perennial forbs---------	5
				Other shrubs----------	2
Lucien part------	Shallow Prairie----------	Favorable	3,000	Little bluestem----------	30
		Normal	2,100	Big bluestem----------	10
		Unfavorable	1,500	Indiangrass----------	10
				Switchgrass----------	5
				Tall dropseed----------	5
				Sideoats grama----------	5
				Other perennial grasses-------	27
				Other perennial forbs---------	5
				Other shrubs----------	3
Summit:					
61----------	Loamy Prairie----------	Favorable	6,500	Little bluestem----------	25
		Normal	4,700	Big bluestem----------	20
		Unfavorable	3,500	Indiangrass----------	10
				Switchgrass----------	5
				Other perennial grasses-------	28
				Other perennial forbs---------	10
				Other shrubs----------	2
[1]62:					
Summit part------	Loamy Prairie----------	Favorable	6,500	Little bluestem----------	25
		Normal	4,700	Big bluestem----------	20
		Unfavorable	3,500	Indiangrass----------	10
				Switchgrass----------	5
				Other perennial grasses-------	28
				Other perennial forbs---------	10
				Other shrubs----------	2
Shidler part-----	Very Shallow----------	Favorable	2,500	Little bluestem----------	30
		Normal	1,300	Sideoats grama----------	25
		Unfavorable	500	Other perennial grasses-------	35
				Other perennial forbs---------	8
				Other shrubs----------	2
Teller:					
63----------	Loamy Prairie----------	Favorable	6,500	Little bluestem----------	25
		Normal	4,700	Big bluestem----------	20
		Unfavorable	3,500	Indiangrass----------	10
				Switchgrass----------	5
				Other perennial grasses-------	33
				Other perennial forbs---------	5
				Other shrubs----------	2
Vanoss:					
64, 65----------	Loamy Prairie----------	Favorable	6,500	Little bluestem----------	25
		Normal	4,700	Big bluestem----------	20
		Unfavorable	3,500	Indiangrass----------	10
				Switchgrass----------	5
				Other perennial grasses-------	33
				Other perennial forbs---------	5
				Other shrubs----------	2

See footnote at end of table.

TABLE 7.--RANGE PRODUCTIVITY AND COMPOSITION--Continued

Soil name and map symbol	Range site	Total production		Common plant name	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
Verdigris:					
66	Loamy Bottomland	Favorable	10,000	Big bluestem	40
		Normal	8,500	Indiangrass	20
		Unfavorable	6,000	Switchgrass	10
				Eastern gamagrass	8
				Little bluestem	5
				Prairie cordgrass	3
				Maximilian sunflower	3
				Other perennial grasses	6
				Other trees	5
[1]67	Loamy Bottomland	Favorable	10,000	Big bluestem	40
		Normal	8,500	Indiangrass	20
		Unfavorable	6,000	Switchgrass	10
				Eastern gamagrass	8
				Little bluestem	5
				Prairie cordgrass	3
				Maximilian sunflower	3
				Other perennial grasses	6
				Other trees	5
Wolco:					
68	Loamy Prairie	Favorable	5,000	Little bluestem	35
		Normal	3,500	Big bluestem	10
		Unfavorable	2,500	Indiangrass	10
				Switchgrass	10
				Other perennial grasses	28
				Other perennial forbs	5
				Other shrubs	2
[1]69:					
Wolco part	Loamy Prairie	Favorable	5,000	Little bluestem	35
		Normal	3,500	Big bluestem	10
		Unfavorable	2,500	Indiangrass	10
				Switchgrass	10
				Other perennial grasses	28
				Other perennial forbs	5
				Other shrubs	2
Dwight part	Shallow Claypan	Favorable	4,000	Little bluestem	20
		Normal	3,000	Big bluestem	15
		Unfavorable	2,000	Prairie dropseed	10
				Western wheatgrass	10
				Switchgrass	5
				Sideoats grama	5
				Buffalograss	2
				Other perennial grasses	28
				Other perennial forbs	5
Wynona:					
70	Loamy Bottomland	Favorable	10,000	Switchgrass	25
		Normal	8,800	Indiangrass	20
		Unfavorable	8,000	Big bluestem	15
				Little bluestem	10
				Eastern gamagrass	5
				Sedges	5
				Compassplant	5
				Other perennial grasses	10
				Other trees	5

[1]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 8.--HEIGHT OF TREES IN WINDBREAKS AND ENVIRONMENTAL PLANTINGS AT AGE 20

[Dashes mean that data are unavailable]

Soil name and map symbol	Austrian pine	Eastern cottonwood	Eastern redcedar	Green ash	Hackberry	Osage-orange	Pecan	Red mulberry	Shortleaf pine
	Ft	Ft	Ft	Ft	Ft	Ft	Ft	Ft	Ft
Apperson:									
1	Not suited	Not suited	20	Not suited	---	20	Not suited	---	---
[1]2:									
Apperson part	Not suited	Not suited	20	Not suited	---	20	Not suited	---	---
Dwight part	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited.
Barnsdall:									
3	35	75	35	55	---	---	---	---	---
Bates:									
4, 5	30	---	30	---	---	---	---	---	35
[1]6:									
Catoosa part	30	---	30	---	---	---	---	---	35
Shidler part	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited.
Choska:									
7	30	65	30	Not suited	Not suited	---	Not suited	---	---
Cleora:									
8, 9	30	65	30	Not suited	Not suited	---	Not suited	---	---
Corbin:									
10, 11	30	---	30	---	---	---	---	---	35
[1]12:									
Corbin part	30	---	30	---	---	---	---	---	35
Pawhuska part	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited.
Coweta:									
[1]13:									
Coweta part	Not suited	Not suited	---	Not suited	Not suited	Not suited	Not suited	Not suited	---
Bates part	30	---	30	---	---	---	---	---	35
Darnell:									
[1]14:									
Darnell part	Not suited	---	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	---
Stephenville part	30	---	30	---	---	---	---	---	35
Dennis:									
15, 16	Not suited	Not suited	20	Not suited	---	20	Not suited	---	---
[1]17:									
Dennis part	Not suited	Not suited	20	Not suited	---	20	Not suited	---	---
Carytown part	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited.
[1]18:									
Dennis part	Not suited	Not suited	20	Not suited	---	20	Not suited	---	---
Verdigris part	35	75	35	55	---	---	---	---	---

See footnote at end of table.

TABLE 8.--HEIGHT OF TREES IN WINDBREAKS AND ENVIRONMENTAL PLANTINGS AT AGE 20--Continued

Soil name and map symbol	Austrian pine	Eastern cottonwood	Eastern redcedar	Green ash	Hackberry	Osage-orange	Pecan	Red mulberry	Shortleaf pine
	Ft	Ft	Ft	Ft	Ft	Ft	Ft	Ft	Ft
Dougherty:									
19, 20	Not suited	Not suited	25	Not suited	Not suited	Not suited	Not suited	Not suited	---
Eufaula:									
21	Not suited	Not suited	20	Not suited	Not suited	Not suited	Not suited	Not suited	---
[1]22:									
Eufaula part	Not suited	Not suited	20	Not suited	Not suited	Not suited	Not suited	Not suited	---
Dougherty part	Not suited	Not suited	25	Not suited	Not suited	Not suited	Not suited	Not suited	---
Foraker:									
[1]23:									
Foraker part	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited.
Shidler part	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited.
Gasil:									
24	30	---	30	---	---	---	---	---	35
Grainola:									
[1]25:									
Grainola part	Not suited	Not suited	---	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited.
Shidler part	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited.
Kiomatia:									
26, 27	Not suited	60	25	Not suited	Not suited	---	Not suited	Not suited	---
Konawa:									
28	Not suited	Not suited	25	Not suited	Not suited	Not suited	Not suited	Not suited	---
Lighting:									
29	Not suited	60	---	40	---	---	---	---	Not suited.
Lula:									
30	30	---	30	---	---	---	---	---	35
Mason:									
31, 32	35	75	35	55	---	---	---	---	---
[1]33:									
Mason part	35	75	35	55	---	---	---	---	---
Drummond part	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited.
Minco:									
34	30	---	30	---	---	---	---	---	35
Niotaze:									
[1]35, [1]36, [1]37	Not suited	Not suited	20	Not suited	---	20	Not suited	---	---
Darnell part	Not suited	Not suited	---	Not suited	Not suited	Not suited	Not suited	Not suited	---
Norge:									
38, 39, 40, 41	30	---	30	---	---	---	---	---	35
[1]42:									
Norge part	30	---	30	---	---	---	---	---	35
Dennis part	Not suited	Not suited	20	Not suited	---	20	Not suited	---	---
Prue part	30	---	30	---	---	---	---	---	35

See footnote at end of table.

TABLE 8.--HEIGHT OF TREES IN WINDBREAKS AND ENVIRONMENTAL PLANTINGS AT AGE 20--Continued

Soil name and map symbol	Austrian pine	Eastern cottonwood	Eastern redcedar	Green ash	Hackberry	Osage-orange	Pecan	Red mulberry	Shortleaf pine
	Ft	Ft	Ft	Ft	Ft	Ft	Ft	Ft	Ft
[1]43:									
Norge part	30	---	30	---	---	---	---	---	35
Pawhuska part	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited.
Oil-waste land:									
44	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited.
Okemah:									
45	Not suited	Not suited	20	Not suited	---	20	Not suited	---	---
Osage:									
46	Not suited	60	---	40	---	---	---	---	Not suited.
Parsons:									
47, 48	Not suited	Not suited	Not suited	Not suited	Not suited	---	Not suited	---	Not suited.
49:									
Parsons part	Not suited	Not suited	Not suited	Not suited	Not suited	---	Not suited	---	Not suited.
Carytown part	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited.
Pits:									
50	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited.
Prue:									
51	30	---	30	---	---	---	---	---	35
Pursley Variant:									
52	35	75	35	55	---	---	---	---	---
Roebuck:									
53	Not suited	60	---	40	---	---	---	---	Not suited.
Shidler:									
[1]54	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited.
Steedman:									
55, 56	Not suited	Not suited	20	Not suited	---	20	Not suited	---	---
[1]57, [1]58	Not suited	Not suited	20	Not suited	---	20	Not suited	---	---
Coweta part	Not suited	Not suited	---	Not suited	Not suited	Not suited	Not suited	Not suited	---
Stephenville:									
[1]59:									
Stephenville part	30	---	30	---	---	---	---	---	35
Darnell part	Not suited	Not suited	---	Not suited	Not suited	Not suited	Not suited	Not suited	---
Stoneburg:									
[1]60:									
Stoneburg part	30	---	30	---	---	---	---	---	35
Lucien part	Not suited	Not suited	---	Not suited	Not suited	Not suited	Not suited	Not suited	---

See footnote at end of table.

TABLE 8.--HEIGHT OF TREES IN WINDBREAKS AND ENVIRONMENTAL PLANTINGS AT AGE 20--Continued

Soil name and map symbol	Austrian pine	Eastern cottonwood	Eastern redcedar	Green ash	Hackberry	Osage-orange	Pecan	Red mulberry	Shortleaf pine
	Ft	Ft	Ft	Ft	Ft	Ft	Ft	Ft	Ft
Summit:									
61	Not suited	Not suited	20	Not suited	---	20	Not suited	---	---
[1]62:									
Summit part	Not suited	Not suited	20	Not suited	---	20	Not suited	---	---
Shidler part	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited.
Teller:									
63	30	---	30	---	---	---	---	---	35
Vanoss:									
64, 65	30	---	30	---	---	---	---	---	35
Verdigris:									
66, [1]67	35	75	35	55	---	---	---	---	---
Wolco:									
68	Not suited	Not suited	20	Not suited	---	20	Not suited	---	---
[1]69:									
Wolco part	Not suited	Not suited	20	Not suited	---	20	Not suited	---	---
Dwight part	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited.
Wynona:									
70	35	75	35	55	---	---	---	---	35

[1]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 9.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates the soil was not rated]

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Apperson:												
1	Good	Good	Fair	Good	Good	---	Poor	Poor	Good	Good	Poor	Fair.
[1]2:												
Apperson part	Good	Good	Fair	Good	Good	---	Poor	Poor	Good	Good	Poor	Fair.
Dwight part	Fair	Fair	Fair	---	---	Fair	Poor	Fair	Fair	---	Poor	Poor.
Barnsdall:												
3	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
Bates:												
4, 5	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	Fair.
Catoosa:												
[1]6:												
Catoosa part	Fair	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	Fair.
Shidler part	Very poor.	Very poor.	Poor	---	---	Poor	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
Choska:												
7	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
Cleora:												
8, 9	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
Corbin:												
10, 11	Good	Good	Fair	---	---	Fair	Poor	Very poor.	Good	---	Very poor.	Fair.
[1]12:												
Corbin part	Good	Good	Fair	---	---	Fair	Poor	Very poor.	Good	---	Very poor.	Fair.
Pawhuska part	Poor	Poor	Very poor.	---	---	Poor	Very poor.	Poor	Poor	---	Very poor.	Very poor.
Coweta:												
[1]13:												
Coweta part	Very poor.	Poor	Poor	Very poor.	Very poor.	---	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Poor.
Bates part	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	Fair.
Darnell:												
[1]14:												
Darnell part	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Stephenville part	Good	Good	Good	---	---	Good	Poor	Very poor.	Good	---	Very poor.	Good.
Dennis:												
15	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	Good.
16	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	Good.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Dennis:												
[1]17:												
Dennis part	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	Good.
Carytown part	Poor	Fair	Fair	Poor	Poor	---	Good	Good	Fair	Poor	Good	Poor.
[1]18:												
Dennis part	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	Good.
Verdigris part	Poor	Fair	Fair	Good	Good	Good	Poor	Fair	Fair	Good	Poor	---
Dougherty:												
19, 20	Fair	Fair	Good	---	---	Good	Poor	Very poor.	Fair	---	Very poor.	Good.
Eufaula:												
21	Fair	Fair	Fair	---	---	Good	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
[1]22:												
Eufaula part	Fair	Fair	Fair	---	---	Good	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Dougherty part	Fair	Fair	Good	---	---	Good	Poor	Very poor.	Fair	---	Very poor.	Good.
Foraker:												
[1]23:												
Foraker part	Poor	Fair	Fair	---	Fair	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Shidler part	Very poor.	Very poor.	Poor	---	---	Poor	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
Gasil:												
24	Good	Good	Good	Good	---	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Grainola:												
[1]25:												
Grainola part	Poor	Fair	Fair	---	Fair	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Shidler part	Very poor.	Very poor.	Poor	---	---	Poor	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
Kiomatia:												
26, [1]27	Poor	Fair	Fair	Fair	---	---	Poor	Very poor.	Fair	Fair	Very poor.	---
Konawa:												
28	Fair	Fair	Good	---	---	Good	Poor	Very poor.	Fair	---	Very poor.	Good.
Lightning:												
29	Fair	Good	Fair	Good	Good	---	Fair	Fair	Fair	Good	Fair	---
Lula:												
30	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	Good.
Mason:												
31, 32	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
[1]33:												
Mason part	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Mason:												
Drummond part----	Poor	Fair	Fair	---	Poor	Poor	Fair	Fair	Fair	---	Fair	Poor.
Minco:												
34----------	Fair	Good	Good	---	---	Good	Poor	Very poor.	Good	---	Very poor.	Good.
Niotaze:												
[1]35:												
Niotaze part-----	Very poor.	Poor	Fair	Fair	Poor	---	Very poor.	Very poor.	Fair	Good	Very poor.	Fair.
Darnell part-----	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
[1]36:												
Niotaze part-----	Very poor.	Poor	Fair	Fair	Poor	---	Very poor.	Very poor.	Fair	Good	Very poor.	Fair.
Darnell part-----	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
[1]37:												
Niotaze part-----	Very poor.	Poor	Fair	Fair	Poor	---	Very poor.	Very poor.	Fair	Good	Very poor.	Fair.
Darnell part-----	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Norge:												
38, 39, 41-------	Good	Good	Fair	---	---	Fair	Poor	Very poor.	Good	---	Very poor.	Fair.
40----------	Fair	Good	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
[1]42:												
Norge part------	Fair	Good	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
Dennis part------	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	Good.
Prue part-------	Fair	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	Good.
[1]43:												
Norge part------	Good	Good	Fair	---	---	Fair	Poor	Very poor.	Good	---	Very poor.	Fair.
Pawhuska part----	Poor	Poor	Very poor.	---	---	Poor	Very poor.	Poor	Poor	---	Very poor.	Very poor.
Oil-waste land:												
44----------	---	---	---	---	---	---	---	---	---	---	---	---
Okemah:												
45----------	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	Good.
Osage:												
46----------	Fair	Fair	Fair	Fair	Fair	---	Poor	Good	Fair	Fair	Fair	Good.
Parsons:												
47----------	Fair	Good	Good	Good	Good	---	Fair	Fair	Good	Good	Fair	Fair.
48----------	Fair	Good	Good	Good	Good	---	Fair	Poor	Good	Good	Poor	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Parsons:												
[1]49:												
Parsons part	Fair	Good	Good	Good	Good	---	Fair	Poor	Good	Good	Poor	Fair.
Carytown part	Poor	Fair	Fair	Poor	Poor	---	Good	Good	Fair	Poor	Good	Poor.
Pits:												
50	---	---	---	---	---	---	---	---	---	---	---	---
Prue:												
51	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	Good.
Pursley Variant:												
52	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
Roebuck:												
53	Fair	Fair	Poor	Good	Good	---	Poor	Fair	Poor	Fair	Poor	---
Shidler:												
[1]54	Very poor.	Very poor.	Poor	---	---	Poor	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
Steedman:												
55, 56	Fair	Good	Fair	---	Fair	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
[1]57:												
Steedman part	Poor	Poor	Poor	---	Poor	Poor	Very poor.	Very poor.	Poor	---	Very poor.	Poor.
Coweta part	Very poor.	Poor	Poor	Very poor.	Very poor.	---	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Poor.
[1]58:												
Steedman part	Poor	Poor	Poor	---	Poor	Poor	Very poor.	Very poor.	Poor	---	Very poor.	Poor.
Coweta part	Very poor.	Poor	Poor	Very poor.	Very poor.	---	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Poor.
Stephenville:												
[1]59:												
Stephenville part	Fair	Good	Good	---	---	Good	Poor	Very poor.	Good	---	Very poor.	Good.
Darnell part	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Stoneburg:												
[1]60:												
Stoneburg part	Fair	Good	Good	---	---	Good	Very poor.	Very poor.	Good	---	Very poor.	Good.
Lucien part	Poor	Fair	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
Summit:												
61	Fair	Good	Fair	Good	Good	---	Poor	Very poor.	Fair	Good	Very poor.	Good.
[1]62:												
Summit part	Fair	Good	Fair	Good	Good	---	Poor	Very poor.	Fair	Good	Very poor.	Good.
Shidler part	Very poor.	Very poor.	Poor	---	---	Poor	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Teller: 63	Good	Good	Good	---	---	Good	Poor	Very poor.	Good	---	Very poor.	Good.
Vanoss: 64, 65	Good	Good	Good	---	---	Good	Poor	Very poor.	Good	---	Very poor.	Good.
Verdigris: 66	Good	Good	Good	Good	Good	Good	Poor	Fair	Good	Good	Poor	---
[1]67	Poor	Fair	Fair	Good	Good	Good	Poor	Fair	Fair	Good	Poor	---
Wolco: 68	Good	Good	Good	---	---	Fair	Poor	Poor	Good	---	Poor	Good.
[1]69: Wolco part	Good	Good	Good	---	---	Fair	Poor	Poor	Good	---	Poor	Good.
Dwight part	Fair	Fair	Fair	---	---	Fair	Poor	Fair	Fair	---	Poor	Fair.
Wynona: 70	Good	Good	Good	Good	Good	---	Fair	Fair	Good	Good	Fair	---

[1]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 10.--RECREATIONAL DEVELOPMENT

["Shrink-swell" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe"]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Apperson:				
1	Moderate: too clayey, wetness, percs slowly.	Moderate: wetness, too clayey.	Moderate: too clayey, wetness, percs slowly.	Moderate: too clayey.
[1]2:				
Apperson part	Moderate: too clayey, wetness, percs slowly.	Moderate: wetness, too clayey.	Moderate: too clayey, wetness, percs slowly.	Moderate: too clayey.
Dwight part	Severe: percs slowly.	Moderate: wetness.	Severe: percs slowly.	Slight.
Barnsdall:				
3	Severe: floods.	Moderate: floods.	Moderate: floods.	Slight.
Bates:				
4, 5	Slight	Slight	Moderate: slope.	Slight.
Catoosa:				
[1]6:				
Catoosa part	Slight	Slight	Moderate: depth to rock, slope.	Slight.
Shidler part	Severe: large stones.	Moderate: large stones, too clayey.	Severe: depth to rock, large stones.	Severe: large stones.
Choska:				
7	Severe: floods.	Moderate: floods.	Moderate: floods.	Slight.
Cleora:				
8, 9	Severe: floods.	Moderate: floods.	Moderate: floods.	Slight.
Corbin:				
10, 11	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight.
[1]12:				
Corbin part	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight.
Pawhuska part	Severe: percs slowly.	Slight	Severe: percs slowly.	Slight.
Coweta:				
[1]13:				
Coweta part	Slight	Slight	Severe: depth to rock, slope, large stones.	Slight.
Bates part	Slight	Slight	Moderate: slope.	Slight.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Darnell:				
[1]14:				
Darnell part	Slight	Slight	Severe: depth to rock, slope.	Slight.
Stephenville part	Slight	Slight	Moderate: slope.	Slight.
Dennis:				
15, 16	Moderate: wetness, percs slowly.	Slight	Moderate: percs slowly, slope, wetness.	Slight.
[1]17:				
Dennis part	Moderate: wetness, percs slowly.	Slight	Moderate: percs slowly, slope, wetness.	Slight.
Carytown part	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, percs slowly.	Severe: wetness.
[1]18:				
Dennis part	Moderate: wetness, percs slowly.	Slight	Moderate: percs slowly, slope, wetness.	Slight.
Verdigris part	Severe: floods.	Severe: floods.	Severe: floods.	Slight.
Dougherty:				
19, 20	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
Eufaula:				
21	Moderate: too sandy.	Moderate: too sandy.	Severe: slope.	Moderate: too sandy.
[1]22:				
Eufaula part	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
Dougherty part	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
Foraker:				
[1]23:				
Foraker part	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too clayey, slope.
Shidler part	Severe: large stones.	Moderate: too clayey, large stones.	Severe: depth to rock, large stones.	Moderate: too clayey.
Gasil:				
24	Slight	Slight	Moderate: slope.	Slight.
Grainola:				
[1]25:				
Grainola part	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, too clayey.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Grainola:				
[1]25:				
Shidler part	Severe: large stones.	Moderate: too clayey, large stones.	Severe: depth to rock, large stones.	Moderate: too clayey.
Kiomatia:				
26, [1]27	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
Konawa:				
28	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
Lightning:				
29	Severe: floods, percs slowly, wetness.	Moderate: floods, wetness.	Severe: percs slowly, wetness, floods.	Moderate: floods, wetness.
Lula:				
30	Slight	Slight	Moderate: slope.	Slight.
Mason:				
31	Severe: floods.	Moderate: floods.	Moderate: percs slowly, floods.	Slight.
32	Severe: floods.	Moderate: floods.	Moderate: percs slowly, floods, slope.	Slight.
[1]33:				
Mason part	Severe: floods.	Moderate: floods.	Moderate: percs slowly, floods.	Slight.
Drummond part	Severe: floods, percs slowly.	Moderate: floods, wetness.	Severe: percs slowly.	Moderate: wetness.
Minco:				
34	Slight	Slight	Severe: slope.	Slight.
Niotaze:				
[1]35:				
Niotaze part	Moderate: slope, wetness.	Moderate: slope.	Severe: slope.	Moderate: wetness.
Darnell part	Severe: large stones.	Moderate: large stones.	Severe: depth to rock, large stones.	Severe: large stones.
[1]36:				
Niotaze part	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: wetness, slope.
Darnell part	Severe: large stones.	Severe: slope.	Severe: depth to rock, large stones.	Severe: large stones.
[1]37:				
Niotaze part	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Niotaze:				
[1]37:				
Darnell part	Severe: large stones.	Severe: slope.	Severe: depth to rock, large stones.	Severe: large stones.
Norge:				
38, 39, 41	Moderate: percs slowly.	Slight	Moderate: percs slowly, slope.	Slight.
40	Moderate: percs slowly.	Slight	Severe: slope.	Slight.
[1]42:				
Norge part	Moderate: percs slowly.	Slight	Moderate: percs slowly, slope.	Slight.
Dennis part	Moderate: wetness, percs slowly.	Slight	Moderate: percs slowly, slope, wetness.	Slight.
Prue part	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight.
[1]43:				
Norge part	Moderate: percs slowly.	Slight	Moderate: percs slowly, slope.	Slight.
Pawhuska part	Severe: percs slowly.	Slight	Severe: percs slowly.	Slight.
Oil-waste land:				
44	---	---	---	---
Okemah:				
45	Moderate: percs slowly, wetness.	Slight	Moderate: percs slowly, wetness.	Slight.
Osage:				
46	Severe: floods, wetness, percs slowly.	Severe: wetness, floods, too clayey.	Severe: wetness, floods, percs slowly.	Severe: wetness, too clayey.
Parsons:				
47, 48	Severe: percs slowly.	Moderate: wetness.	Severe: percs slowly.	Moderate: wetness.
[1]49:				
Parsons part	Severe: percs slowly.	Moderate: wetness.	Severe: percs slowly.	Moderate: wetness.
Carytown part	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, percs slowly.	Severe: wetness.
Pits:				
50	---	---	---	---
Prue:				
51	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Pursley Variant: 52	Severe: floods.	Moderate: floods.	Moderate: floods.	Slight.
Roebuck: 53	Severe: floods, percs slowly.	Moderate: floods.	Severe: floods, percs slowly.	Moderate: floods, too clayey.
Shidler: [1]54	Severe: large stones.	Moderate: large stones.	Severe: depth to rock, large stones.	Severe: large stones.
Steedman: 55, 56	Moderate: percs slowly, wetness.	Slight	Moderate: percs slowly, slope, wetness.	Slight.
[1]57:				
Steedman part	Severe: large stones.	Severe: large stones.	Severe: large stones, slope.	Severe: large stones.
Coweta part	Severe: large stones.	Severe: large stones.	Severe: depth to rock, slope, large stones.	Severe: large stones.
[1]58:				
Steedman part	Severe: slope, large stones.	Severe: large stones, slope.	Severe: large stones, slope.	Severe: large stones.
Coweta part	Severe: large stones.	Severe: large stones.	Severe: depth to rock, slope, large stones.	Severe: large stones.
Stephenville: [1]59:				
Stephenville part	Slight	Slight	Severe: slope.	Slight.
Darnell part	Slight	Slight	Severe: depth to rock, slope.	Slight.
Stoneburg: [1]60:				
Stoneburg part	Slight	Slight	Severe: slope.	Slight.
Lucien part	Slight	Slight	Severe: depth to rock.	Slight.
Summit: 61	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Moderate: too clayey, percs slowly, slope.	Moderate: too clayey.
[1]62:				
Summit part	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Severe: slope.	Moderate: too clayey.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Summit:				
[1]62:				
Shidler part	Severe: large stones.	Moderate: large stones.	Severe: depth to rock, large stones.	Severe: large stones.
Teller:				
63	Slight	Slight	Moderate: slope.	Slight.
Vanoss:				
64	Slight	Slight	Slight	Slight.
65	Slight	Slight	Moderate: slope.	Slight.
Verdigris:				
66	Severe: floods.	Severe: floods.	Moderate: floods.	Slight.
[1]67	Severe: floods.	Severe: floods.	Severe: floods.	Slight.
Wolco:				
68	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Moderate: percs slowly, too clayey.	Moderate: too clayey.
[1]69:				
Wolco part	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight.
Dwight part	Severe: percs slowly.	Moderate: wetness.	Severe: percs slowly.	Slight.
Wynona:				
70	Severe: floods, wetness.	Moderate: wetness, floods, too clayey.	Severe: floods, wetness.	Moderate: too clayey, wetness, floods.

[1]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 11.—BUILDING SITE DEVELOPMENT

["Shrink-swell" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Apperson:					
1	Severe: too clayey, depth to rock, wetness.	Severe: shrink-swell, low strength, wetness.	Severe: low strength, shrink-swell, wetness.	Severe: low strength, shrink-swell, wetness.	Severe: low strength, shrink-swell.
[1]2:					
Apperson part	Severe: too clayey, depth to rock, wetness.	Severe: shrink-swell, low strength, wetness.	Severe: low strength, shrink-swell, wetness.	Severe: low strength, shrink-swell, wetness.	Severe: low strength, shrink-swell.
Dwight part	Severe: too clayey.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.
Barnsdall:					
3	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, low strength, shrink-swell.
Bates:					
4, 5	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.
Catoosa:					
[1]6:					
Catoosa part	Severe: depth to rock.	Moderate: low strength, depth to rock, shrink-swell.	Severe: depth to rock.	Moderate: low strength, depth to rock, shrink-swell.	Severe: low strength.
Shidler part	Severe: depth to rock.	Severe: depth to rock, low strength.	Severe: depth to rock, low strength.	Severe: depth to rock, low strength.	Severe: depth to rock, low strength.
Choska:					
7	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, low strength.
Cleora:					
8, 9	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, low strength.
Corbin:					
10, 11	Moderate: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
[1]12:					
Corbin part	Moderate: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
Pawhuska part	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Coweta:					
[1]13:					
Coweta part	Moderate: slope, depth to rock.	Moderate: depth to rock, slope.	Moderate: depth to rock, slope.	Moderate: depth to rock, slope.	Moderate: depth to rock, slope.
Bates part	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.
Darnell:					
[1]14:					
Darnell part	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock, slope.	Moderate: depth to rock, low strength.
Stephenville part-	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Moderate: slope.	Moderate: low strength.
Dennis:					
15, 16	Severe: wetness, too clayey.	Severe: shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
[1]17:					
Dennis part	Severe: wetness, too clayey.	Severe: shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
Carytown part	Severe: wetness, too clayey.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.
[1]18:					
Dennis part	Severe: wetness, too clayey.	Severe: shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
Verdigris part	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
Dougherty:					
19	Moderate: cutbanks cave.	Slight	Slight	Slight	Moderate: low strength.
20	Moderate: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: low strength.
Eufaula:					
21	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
[1]22:					
Eufaula part	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
Dougherty part	Moderate: cutbanks cave.	Slight	Slight	Slight	Moderate: low strength.
Foraker:					
[1]23:					
Foraker part	Severe: wetness, slope, too clayey.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: low strength, slope, shrink-swell.	Severe: low strength, slope, shrink-swell.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Foraker:					
Shidler part	Severe: depth to rock.	Severe: depth to rock, low strength.	Severe: depth to rock, low strength.	Severe: depth to rock, low strength.	Severe: depth to rock, low strength.
Gasil:					
24	Slight	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Severe: low strength.
Grainola:					
[1]25:					
Grainola part	Severe: too clayey, slope.	Severe: slope, shrink-swell, low strength.	Severe: low strength, slope, shrink-swell.	Severe: low strength, slope, shrink-swell.	Severe: low strength, slope, shrink-swell.
Shidler part	Severe: depth to rock.	Severe: depth to rock, low strength.	Severe: depth to rock, low strength.	Severe: depth to rock, low strength.	Severe: depth to rock, low strength.
Kiomatia:					
26	Severe: floods, too sandy.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
[1]27	Severe: floods, too sandy.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
Konawa:					
28	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength.
Lightning:					
29	Severe: wetness, floods, too clayey.	Severe: floods, shrink-swell, low strength.	Severe: low strength, floods, shrink-swell.	Severe: low strength, floods, shrink-swell.	Severe: low strength, floods, shrink-swell.
Lula:					
30	Moderate: too clayey, depth to rock.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: low strength, shrink-swell.
Mason:					
31, 32	Moderate: too clayey, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, shrink-swell, floods.
[1]33:					
Mason part	Moderate: too clayey, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, shrink-swell, floods.
Drummond part	Severe: too clayey, wetness.	Severe: floods, shrink-swell, low strength.	Severe: wetness, floods, shrink-swell.	Severe: floods, shrink-swell, low strength.	Severe: low strength, shrink-swell.
Minco:					
34	Slight	Moderate: low strength.	Moderate: low strength.	Moderate: low strength, slope.	Moderate: low strength.
Niotaze:					
[1]35:					
Niotaze part	Severe: wetness.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength, wetness.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Niotaze:					
Darnell part	Severe: large stones.	Severe: large stones.	Severe: large stones.	Severe: large stones.	Moderate: depth to rock, low strength.
[1]36:					
Niotaze part	Severe: wetness.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength, wetness.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
Darnell part	Severe: large stones.	Severe: large stones.	Severe: large stones.	Severe: large stones.	Severe: slope.
[1]37:					
Niotaze part	Severe: wetness.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength, wetness.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
Darnell part	Severe: large stones.	Severe: large stones.	Severe: large stones.	Severe: large stones.	Severe: slope.
Norge:					
38, 41	Moderate: too clayey.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Severe: low strength.
39, 40	Moderate: too clayey.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell, slope.	Severe: low strength.
[1]42:					
Norge part	Moderate: too clayey.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell, slope.	Severe: low strength.
Dennis part	Severe: wetness, too clayey.	Severe: shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
Prue part	Severe: too clayey.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.
[1]43:					
Norge part	Moderate: too clayey.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Severe: low strength.
Pawhuska part	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
Oil-waste land:					
44	---	---	---	---	---
Okemah:					
45	Severe: too clayey, wetness.	Severe: low strength, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Osage: 46	Severe: wetness, floods, too clayey.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.
Parsons: 47, 48	Severe: wetness, too clayey.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: low strength, shrink-swell.
[1]49: Parsons part	Severe: wetness, too clayey.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: low strength, shrink-swell.
Carytown part	Severe: wetness, too clayey.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.
Pits: 50	---	---	---	---	---
Prue: 51	Severe: too clayey.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.
Pursley Variant: 52	Severe: floods, too sandy.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.
Roebuck: 53	Severe: floods, too clayey.	Severe: floods, shrink-swell, low strength.	Severe: floods, shrink-swell, low strength.	Severe: floods, shrink-swell, low strength.	Severe: floods, shrink-swell, low strength.
Shidler: [1]54	Severe: depth to rock, large stones.	Severe: depth to rock, large stones, low strength.	Severe: depth to rock, large stones, low strength.	Severe: depth to rock, large stones, low strength.	Severe: depth to rock, large stones, low strength.
Steedman: 55, 56	Severe: wetness, too clayey.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: low strength, shrink-swell.
[1]57: Steedman part	Severe: wetness, too clayey, large stones.	Severe: shrink-swell, low strength, large stones.	Severe: low strength, shrink-swell, large stones.	Severe: slope, low strength, shrink-swell.	Severe: low strength, shrink-swell, large stones.
Coweta part	Moderate: slope, depth to rock.	Moderate: depth to rock, slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: depth to rock, slope.
[1]58: Steedman part	Severe: too clayey, slope, large stones.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, low strength, shrink-swell.	Severe: low strength, slope, shrink-swell.

See footnote at end of table.

TABLE 11.—BUILDING SITE DEVELOPMENT—Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Steedman:					
Coweta part	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Stephenville:					
[1]59:					
Stephenville part	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Moderate: slope.	Moderate: low strength.
Darnell part	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock, low strength.
Stoneburg:					
[1]60:					
Stoneburg part	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock, slope.	Moderate: depth to rock.
Lucien part	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.
Summit:					
61	Severe: too clayey.	Severe: low strength, shrink-swell.	Severe: wetness, shrink-swell, low strength.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.
[1]62:					
Summit part	Severe: too clayey.	Severe: low strength, shrink-swell.	Severe: wetness, shrink-swell, low strength.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.
Shidler part	Severe: depth to rock, large stones.	Severe: depth to rock, large stones, low strength.	Severe: depth to rock, large stones, low strength.	Severe: depth to rock, large stones, low strength.	Severe: depth to rock, large stones, low strength.
Teller:					
63	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength.
Vanoss:					
64, 65	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: low strength, shrink-swell.
Verdigris:					
66	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
[1]67	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
Wolco:					
68	Severe: wetness, too clayey.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: low strength, shrink-swell.
[1]69:					
Wolco part	Severe: wetness, too clayey.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: low strength, shrink-swell.
Dwight part	Severe: too clayey.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.

See footnote at end of table.

TABLE 11.—BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Wynona: 70	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, low strength.	Severe: floods,

[1]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 12.--SANITARY FACILITIES

["Shrink-swell" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe," and other terms used to rate soils. Absence of an entry means soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Apperson:					
1	Severe: percs slowly, depth to rock, wetness.	Moderate: depth to rock, wetness.	Severe: too clayey, depth to rock, wetness.	Severe: wetness.	Poor: too clayey.
[1]2:					
Apperson part	Severe: percs slowly, depth to rock, wetness.	Moderate: depth to rock, wetness.	Severe: too clayey, depth to rock, wetness.	Severe: wetness.	Poor: too clayey.
Dwight part	Severe: percs slowly.	Moderate: depth to rock.	Severe: too clayey, depth to rock.	Slight	Poor: too clayey.
Barnsdall:					
3	Moderate: floods.	Moderate: seepage.	Moderate: seepage, floods, too clayey.	Moderate: floods.	Fair: too clayey.
Bates:					
4, 5	Severe: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Slight	Fair: thin layer.
Catoosa:					
[1]6:					
Catoosa part	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Fair: thin layer.
Shidler part	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: thin layer, area reclaim.
Choska:					
7	Severe: floods.	Severe: floods, seepage.	Severe: seepage, floods.	Severe: floods.	Good.
Cleora:					
8, 9	Severe: floods.	Severe: seepage, floods.	Severe: floods, seepage.	Severe: floods, seepage.	Good.
Corbin:					
10	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey, thin layer.
11	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey, thin layer.
[1]12:					
Corbin part	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey, thin layer.
Pawhuska part	Severe: percs slowly.	Moderate: slope.	Moderate: slope.	Slight	Poor: too clayey.
Coweta:					
[1]13:					
Coweta part	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: thin layer.

See footnote at end of table.

TABLE 12.—SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Coweta:					
Bates part	Severe: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Slight	Fair: thin layer.
Darnell:					
[1]14:					
Darnell part	Severe: depth to rock.	Severe: depth to rock, seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: thin layer.
Stephenville part-	Severe: depth to rock.	Severe: depth to rock, slope.	Moderate: depth to rock.	Slight	Fair: thin layer.
Dennis:					
15, 16	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey.	Severe: wetness.	Poor: thin layer, too clayey.
[1]17:					
Dennis part	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey.	Severe: wetness.	Poor: thin layer, too clayey.
Carytown part	Severe: percs slowly, wetness.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, wetness, hard to pack.
[1]18:					
Dennis part	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey.	Severe: wetness.	Poor: thin layer, too clayey.
Verdigris part	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
Dougherty:					
19, 20	Slight	Severe: seepage.	Severe: seepage.	Slight	Fair: too sandy.
Eufaula:					
21	Moderate: slope.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
[1]22:					
Eufaula part	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
Dougherty part	Slight	Severe: seepage.	Severe: seepage.	Slight	Fair: too sandy.
Foraker:					
[1]23:					
Foraker part	Severe: percs slowly, slope, depth to rock.	Severe: wetness, depth to rock, slope.	Severe: wetness, too clayey, depth to rock.	Severe: wetness, slope.	Poor: too clayey, slope.
Shidler part	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: thin layer, area reclaim.
Gasil:					
24	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Good.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Grainola:					
[1]25:					
Grainola part	Severe: percs slowly, slope, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: slope.	Poor: too clayey, slope.
Shidler part	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: thin layer, area reclaim.
Kiomatia:					
26	Severe: floods.	Severe: floods, seepage.	Severe: floods, seepage.	Severe: floods, seepage.	Fair: too sandy.
[1]27	Severe: floods.	Severe: floods, seepage.	Severe: floods, seepage.	Severe: floods, seepage.	Fair: too sandy.
Konawa:					
28	Slight	Severe: seepage.	Severe: seepage.	Slight	Fair: thin layer.
Lightning:					
29	Severe: percs slowly, wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods, too clayey.	Severe: wetness, floods.	Poor: too clayey.
Lula:					
30	Moderate: depth to rock.	Moderate: seepage, depth to rock.	Severe: depth to rock.	Slight	Fair: too clayey.
Mason:					
31	Severe: percs slowly.	Slight	Moderate: floods, too clayey.	Moderate: floods.	Fair: thin layer, too clayey.
32	Severe: percs slowly.	Moderate: slope.	Moderate: floods, too clayey.	Moderate: floods.	Fair: thin layer, too clayey.
[1]33:					
Mason part	Severe: percs slowly.	Slight	Moderate: floods, too clayey.	Moderate: floods.	Fair: thin layer, too clayey.
Drummond part	Severe: percs slowly, wetness.	Severe: wetness.	Severe: too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
Minco:					
34	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
Niotaze:					
[1]35:					
Niotaze part	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Moderate: too clayey, wetness, depth to rock.	Moderate: wetness.	Poor: too clayey.
Darnell part	Severe: depth to rock.	Severe: depth to rock, seepage, slope.	Severe: seepage, large stones.	Severe: seepage.	Poor: thin layer, large stones.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Niotaze:					
[1]36:					
Niotaze part	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Moderate: too clayey, wetness, depth to rock.	Severe: slope.	Poor: too clayey.
Darnell part	Severe: depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: seepage, large stones.	Severe: seepage, slope.	Poor: thin layer, large stones.
[1]37:					
Niotaze part	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Moderate: too clayey, wetness, depth to rock.	Severe: slope.	Poor: too clayey.
Darnell part	Severe: depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: seepage, large stones.	Severe: seepage, slope.	Poor: thin layer, large stones.
Norge:					
38, 39, 40, 41	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: thin layer, too clayey.
[1]42:					
Norge part	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: thin layer, too clayey.
Dennis part	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey.	Severe: wetness.	Poor: thin layer, too clayey.
Prue part	Severe: percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey.
[1]43:					
Norge part	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: thin layer, too clayey.
Pawhuska part	Severe: percs slowly.	Moderate: slope.	Moderate: slope.	Slight	Poor: too clayey.
Oil-waste land:					
44	---	---	---	---	---
Okemah:					
45	Severe: percs slowly, wetness.	Slight	Severe: too clayey.	Severe: wetness.	Fair: thin layer, too clayey.
Osage:					
46	Severe: percs slowly, floods, wetness.	Severe: wetness, floods.	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: wetness, too clayey.
Parsons:					
47	Severe: percs slowly, wetness.	Slight	Severe: too clayey.	Severe: wetness.	Poor: too clayey.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Parsons: 48	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey.	Severe: wetness.	Poor: too clayey.
[1]49: Parsons part	Severe: percs slowly, wetness.	Slight	Severe: too clayey.	Severe: wetness.	Poor: too clayey.
Carytown part	Severe: percs slowly, wetness.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, wetness, hard to pack.
Pits: 50	---	---	---	---	---
Prue: 51	Severe: percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey.
Pursley Variant: 52	Severe: floods.	Severe: seepage, floods.	Severe: floods, seepage, too sandy.	Severe: floods, seepage.	Fair: too sandy.
Roebuck: 53	Severe: percs slowly, floods.	Severe: floods.	Severe: floods, too clayey.	Severe: floods.	Poor: too clayey, hard to pack.
Shidler: [1]54	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Slight	Poor: thin layer, area reclaim, large stones.
Steedman: 55, 56	Severe: percs slowly, wetness, depth to rock.	Severe: depth to rock, wetness.	Severe: depth to rock, wetness, too clayey.	Severe: wetness.	Poor: too clayey.
[1]57: Steedman part	Severe: percs slowly, wetness, depth to rock.	Severe: depth to rock, large stones, slope.	Severe: wetness, too clayey, large stones.	Severe: wetness.	Poor: too clayey, large stones.
Coweta part	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer.
[1]58: Steedman part	Severe: percs slowly, slope, depth to rock.	Severe: depth to rock, large stones, slope.	Severe: wetness, too clayey, large stones.	Severe: wetness, slope.	Poor: too clayey, slope, large stones.
Coweta part	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope.	Poor: thin layer.
Stephenville: [1]59: Stephenville part	Severe: depth to rock.	Severe: depth to rock, slope.	Moderate: depth to rock.	Slight	Fair: thin layer.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Stephenville:					
Darnell part	Severe: depth to rock.	Severe: depth to rock, seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: thin layer.
Stoneburg:					
[1]60:					
Stoneburg part	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Slight	Fair: thin layer.
Lucien part	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: seepage, depth to rock.	Severe: seepage.	Poor: thin layer.
Summit:					
61	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey, wetness.	Severe: wetness.	Poor: too clayey.
[1]62:					
Summit part	Severe: percs slowly, wetness.	Severe: slope.	Severe: too clayey, wetness.	Severe: wetness.	Poor: too clayey.
Shidler part	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Slight	Poor: thin layer, area reclaim, large stones.
Teller:					
63	Slight	Severe: seepage.	Severe: seepage.	Slight	Good.
Vanoss:					
64, 65	Slight	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
Verdigris:					
66	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
[1]67	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
Wolco:					
68	Severe: percs slowly, wetness.	Moderate: depth to rock, slope.	Severe: wetness, too clayey, depth to rock.	Severe: wetness.	Poor: too clayey.
[1]69:					
Wolco part	Severe: percs slowly, wetness.	Moderate: depth to rock.	Severe: wetness, too clayey, depth to rock.	Severe: wetness.	Poor: too clayey.
Dwight part	Severe: percs slowly.	Moderate: depth to rock.	Severe: too clayey, depth to rock.	Slight	Poor: too clayey.
Wynona:					
70	Severe: percs slowly, wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Fair: too clayey.

[1]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 13.—CONSTRUCTION MATERIALS

["Shrink-swell" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," and "unsuited." Absence of an entry means soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Apperson:				
1	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, thin layer.
[1]2:				
Apperson part	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, thin layer.
Dwight part	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, too clayey.
Barnsdall:				
3	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Bates:				
4, 5	Poor: thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Catoosa:				
[1]6:				
Catoosa part	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Shidler part	Poor: thin layer, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: area reclaim.
Choska:				
7	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Cleora:				
8, 9	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Corbin:				
10, 11	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
[1]12:				
Corbin part	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Pawhuska part	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, excess salt.
Coweta:				
[1]13:				
Coweta part	Fair: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Bates part	Poor: thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Good.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Darnell:				
[1]14:				
Darnell part	Fair: low strength, thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Stephenville part	Fair: thin layer, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Dennis:				
15, 16	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
[1]17:				
Dennis part	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Carytown part	Poor: shrink-swell, wetness, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: area reclaim, wetness, excess sodium.
[1]18:				
Dennis part	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Verdigris part	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Dougherty:				
19, 20	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Poor: too sandy.
Eufaula:				
21	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Poor: too sandy.
[1]22:				
Eufaula part	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Poor: too sandy.
Dougherty part	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Poor: too sandy.
Foraker:				
[1]23:				
Foraker part	Poor: thin layer, low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Shidler part	Poor: thin layer, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: area reclaim.
Gasil:				
24	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Grainola:				
[1]25:				
Grainola part	Poor: low strength, shrink-swell, thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.

See footnote at end of table.

TABLE 13.—CONSTRUCTION MATERIALS—Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Grainola:				
Shidler part	Poor: thin layer, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: area reclaim.
Kiomatia:				
26, [1]27	Good	Poor: excess fines.	Unsuited: excess fines.	Poor: too sandy.
Konawa:				
28	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Poor: too sandy.
Lightning:				
29	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Lula:				
30	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Mason:				
31, 32	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
[1]33:				
Mason part	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Drummond part	Poor: low strength, shrink-swell, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: area reclaim.
Minco:				
34	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Niotaze:				
[1]35:				
Niotaze part	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: large stones.
Darnell part	Fair: thin layer, large stones.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: large stones.
[1]36:				
Niotaze part	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: large stones.
Darnell part	Fair: thin layer, large stones.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: large stones.
[1]37:				
Niotaze part	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: large stones.
Darnell part	Poor: slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: large stones.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Norge: 38, 39, 40, 41	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
[1]42: Norge part	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Dennis part	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Prue part	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
[1]43: Norge part	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Pawhuska part	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, excess salt.
Oil-waste land: 44	---	---	---	---
Okemah: 45	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Osage: 46	Poor: wetness, low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
Parsons: 47, 48	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
[1]49: Parsons part	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Carytown part	Poor: shrink-swell, wetness, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: area reclaim, wetness, excess sodium.
Pits: 50	---	---	---	---
Prue: 51	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Pursley Variant: 52	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Roebuck: 53	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.

See footnote at end of table.

TABLE 13.—CONSTRUCTION MATERIALS—Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Shidler:				
[1]54	Poor: thin layer, low strength, large stones.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: area reclaim, large stones.
Steedman:				
55, 56	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer.
[1]57:				
Steedman part	Poor: low strength, shrink-swell, large stones.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, large stones.
Coweta part	Fair: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
[1]58:				
Steedman part	Poor: low strength, shrink-swell, large stones.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, slope, large stones.
Coweta part	Fair: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Stephenville:				
[1]59:				
Stephenville part	Fair: thin layer, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Darnell part	Fair: low strength, thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Stoneburg:				
[1]60:				
Stoneburg part	Poor: thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Lucien part	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Summit:				
61	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
[1]62:				
Summit part	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Shidler part	Poor: thin layer, low strength, large stones.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: area reclaim, large stones.
Teller:				
63	Good	Unsuited: excess fines.	Unsuited: excess fines.	Good.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Vanoss: 64, 65	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Verdigris: 66, [1]67	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Wolco: 68	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, too clayey.
[1]69: Wolco part	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Dwight part	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer.
Wynona: 70	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.

[1]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 14.--WATER MANAGEMENT

["Seepage" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not evaluated]

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
Apperson:						
1	Moderate: depth to rock.	Moderate: unstable fill, thin layer, compressible.	Severe: slow refill.	Wetness, percs slowly.	Percs slowly, wetness.	Percs slowly, wetness.
1,2:						
Apperson part	Moderate: depth to rock.	Moderate: unstable fill, thin layer, compressible.	Severe: slow refill.	Wetness, percs slowly.	Percs slowly, wetness.	Percs slowly, wetness.
Dwight part	Moderate: depth to rock.	Moderate: shrink-swell, low strength.	Severe: no water.	Favorable	Percs slowly	Percs slowly, excess sodium, excess salt.
Barnsdall:						
3	Moderate: seepage.	Moderate: unstable fill, piping.	Severe: deep to water.	Not needed	Not needed	Favorable.
Bates:						
4, 5	Moderate: depth to rock, erodes easily.	Moderate: thin layer.	Severe: no water.	Not needed	Slope, depth to rock, erodes easily.	Slope, erodes easily, rooting depth.
Catoosa:						
1,6:						
Catoosa part	Severe: depth to rock.	Moderate: unstable fill, piping, thin layer.	Severe: no water.	Not needed	Depth to rock, rooting depth, droughty.	Rooting depth, droughty.
Shidler part	Severe: depth to rock.	Severe: depth to rock.	Severe: no water.	Not needed	Depth to rock	Rooting depth.
Choska:						
7	Moderate: seepage.	Moderate: unstable fill, compressible, piping.	Severe: deep to water.	Not needed	Favorable	Favorable.
Cleora:						
8, 9	Severe: seepage.	Moderate: piping, unstable fill, seepage.	Severe: deep to water.	Not needed	Favorable	Favorable.
Corbin:						
10, 11	Slight: favorable.	Moderate: shrink-swell, low strength.	Severe: no water.	Favorable	Percs slowly	Percs slowly.
1,12:						
Corbin part	Slight: favorable.	Moderate: shrink-swell, low strength.	Severe: no water.	Favorable	Percs slowly	Percs slowly.
Pawhuska part	Slight	Severe: unstable fill.	Severe: no water.	Excess salt, percs slowly.	Percs slowly, excess salt.	Percs slowly, excess salt.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
Coweta:						
[1]13:						
Coweta part	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Not needed	Depth to rock, rooting depth, slope.	Droughty, rooting depth, slope.
Bates part	Moderate: depth to rock, erodes easily.	Moderate: thin layer.	Severe: no water.	Not needed	Slope, depth to rock, erodes easily.	Slope, erodes easily, rooting depth.
Darnell:						
[1]14:						
Darnell part	Severe: depth to rock, seepage.	Severe: thin layer.	Severe: no water.	Not needed	Depth to rock, erodes easily.	Rooting depth.
Stephenville part	Severe: depth to rock.	Moderate: thin layer.	Severe: no water.	Not needed	Erodes easily	Erodes easily.
Dennis:						
15, 16	Slight	Moderate: unstable fill, compressible, piping.	Severe: no water.	Percs slowly	Percs slowly	Percs slowly.
[1]17:						
Dennis part	Slight	Moderate: unstable fill, compressible, piping.	Severe: no water.	Percs slowly	Percs slowly	Percs slowly.
Carytown part	Slight	Unstable fill, compressible, shrink-swell.	Severe: no water.	Percs slowly, wetness, excess sodium.	Percs slowly, wetness.	Percs slowly, wetness, excess sodium.
[1]18:						
Dennis part	Slight	Moderate: unstable fill, compressible, piping.	Severe: no water.	Percs slowly	Percs slowly	Percs slowly.
Verdigris part	Moderate: seepage.	Moderate: low strength, piping.	Severe: deep to water.	Floods	Floods	Favorable.
Dougherty:						
19, 20	Severe: seepage.	Moderate: unstable fill, compressible, piping.	Severe: no water.	Not needed	Erodes easily, too sandy.	Erodes easily, fast intake.
Eufaula:						
21	Severe: seepage.	Moderate: unstable fill, piping.	Severe: no water.	Not needed	Seepage, fast intake, droughty.	Erodes easily, droughty, fast intake.
[1]22:						
Eufaula part	Severe: seepage.	Moderate: unstable fill, piping.	Severe: no water.	Not needed	Seepage, fast intake, droughty.	Erodes easily, droughty, fast intake.
Dougherty part	Severe: seepage.	Moderate: unstable fill, compressible, piping.	Severe: no water.	Not needed	Erodes easily, too sandy.	Erodes easily, fast intake.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
Foraker:						
[1]23:						
Foraker part	Slight	Severe: compressible, shrink-swell.	Severe: slow refill.	Percs slowly, slope.	Percs slowly, slope.	Percs slowly, slope.
Shidler part	Severe: depth to rock.	Severe: depth to rock.	Severe: no water.	Not needed	Depth to rock	Rooting depth.
Gasil:						
24	Moderate: seepage.	Slight	Severe: no water.	Not needed	Erodes easily	Erodes easily.
Grainola:						
[1]25:						
Grainola part	Slight	Severe: compressible, shrink-swell.	Severe: no water.	Percs slowly, slope.	Percs slowly, slope.	Percs slowly, slope.
Shidler part	Severe: depth to rock.	Severe: depth to rock.	Severe: no water.	Not needed	Depth to rock	Rooting depth.
Kiomatia:						
26	Severe: seepage.	Severe: piping.	Severe: deep to water.	Not needed	Too sandy	Floods.
[1]27	Severe: seepage.	Severe: piping.	Severe: deep to water.	Floods, cutbanks cave.	Too sandy	Floods.
Konawa:						
28	Severe: seepage.	Moderate: low strength, unstable fill, piping.	Severe: deep to water.	Not needed	Erodes easily	Erodes easily.
Lightning:						
29	Slight	Moderate: unstable fill, compressible.	Severe: slow refill.	Floods, percs slowly.	Not needed	Wetness.
Lula:						
30	Moderate: thin layer, seepage.	Moderate: thin layer, piping.	Severe: no water.	Not needed	Favorable	Favorable.
Mason:						
31, 32	Moderate: seepage.	Moderate: unstable fill, piping, compressible.	Severe: no water.	Not needed	Not needed	Not needed.
[1]33:						
Mason part	Moderate: seepage.	Moderate: unstable fill, piping, compressible.	Severe: no water.	Not needed	Not needed	Not needed.
Drummond part	Slight	Severe: unstable fill, piping.	Severe: slow refill.	Cutbanks cave, floods, percs slowly.	Percs slowly, erodes easily, piping.	Droughty, erodes easily, excess salt.
Minco:						
34	Moderate: seepage.	Moderate: unstable fill, compressible, piping.	Severe: no water.	Not needed	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
Niotaze:						
[1]35:						
Niotaze part	Moderate: depth to rock.	Severe: low strength, shrink-swell, thin layer.	Severe: no water.	Wetness	Slope	Slope.
Darnell part	Severe: depth to rock, seepage.	Severe: thin layer.	Severe: no water.	Not needed	Slope	Slope.
[1]36:						
Niotaze part	Moderate: depth to rock.	Severe: low strength, shrink-swell, thin layer.	Severe: no water.	Wetness	Slope	Slope.
Darnell part	Severe: depth to rock, seepage.	Severe: thin layer.	Severe: no water.	Not needed	Slope	Slope.
[1]37:						
Niotaze part	Moderate: depth to rock.	Severe: low strength, shrink-swell, thin layer.	Severe: no water.	Wetness	Slope	Slope.
Darnell part	Severe: depth to rock, seepage.	Severe: thin layer.	Severe: no water.	Not needed	Slope	Slope.
Norge:						
38, 39, 40, 41	Moderate: seepage.	Moderate: piping, unstable fill.	Severe: no water.	Not needed	Erodes easily	Erodes easily.
[1]42:						
Norge part	Moderate: seepage.	Moderate: piping, unstable fill.	Severe: no water.	Not needed	Erodes easily	Erodes easily.
Dennis part	Slight	Moderate: unstable fill, compressible, piping.	Severe: no water.	Percs slowly	Percs slowly	Percs slowly.
Prue part	Moderate: seepage.	Moderate: unstable fill, compressible.	Severe: slow refill.	Percs slowly	Percs slowly	Percs slowly.
[1]43:						
Norge part	Moderate: seepage.	Moderate: piping, unstable fill.	Severe: no water.	Not needed	Erodes easily	Erodes easily.
Pawhuska part	Slight	Severe: unstable fill.	Severe: no water.	Excess salt, percs slowly.	Percs slowly, excess salt.	Percs slowly, excess salt.
Oil-waste land: 44	---	---	---	---	---	---
Okemah: 45	Slight	Moderate: unstable fill.	Severe: no water.	Percs slowly	Percs slowly	Percs slowly.
Osage: 46	Favorable	Severe: shrink-swell, low strength, compressible.	Severe: slow refill.	Floods, percs slowly, wetness.	Percs slowly, wetness.	Percs slowly, wetness.

See footnote at end of table.

TABLE 14.—WATER MANAGEMENT—Continued

Soil name and map symbol	Limitations for—			Features affecting—		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
Parsons: 47, 48	Slight	Moderate: unstable fill, compressible.	Severe: no water.	Percs slowly, wetness.	Percs slowly, wetness.	Percs slowly, wetness.
[1]49: Parsons part	Slight	Moderate: unstable fill, compressible.	Severe: no water.	Percs slowly, wetness.	Percs slowly, wetness.	Percs slowly, wetness.
Carytown part	Slight	Unstable fill, compressible, shrink-swell.	Severe: no water.	Percs slowly, wetness, excess sodium.	Percs slowly, wetness.	Percs slowly, wetness, excess sodium.
Pits: 50	---	---	---	---	---	---
Prue: 51	Moderate: seepage.	Moderate: unstable fill, compressible.	Severe: slow refill.	Percs slowly	Percs slowly	Percs slowly.
Pursley Variant: 52	Severe: seepage.	Moderate: unstable fill, compressible, piping.	Severe: deep to water.	Not needed	Not needed	Favorable.
Roebuck: 53	Slight	Moderate: compressible, unstable fill.	Severe: deep to water.	Floods, percs slowly.	Percs slowly	Percs slowly.
Shidler: [1]54	Severe: depth to rock.	Severe: depth to rock, large stones.	Severe: no water.	Not needed	Depth to rock, large stones.	Rooting depth, large stones.
Steedman: 55, 56	Slight	Severe: compressible, shrink-swell.	Severe: no water.	Percs slowly	Percs slowly	Percs slowly.
[1]57: Steedman part	Slight	Severe: compressible, shrink-swell, large stones.	Severe: no water.	Percs slowly	Percs slowly, large stones.	Percs slowly, large stones.
Coweta part	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Not needed	Depth to rock, rooting depth, slope.	Droughty, rooting depth, slope.
[1]58: Steedman part	Slight	Severe: compressible, shrink-swell, large stones.	Severe: no water.	Percs slowly	Percs slowly, large stones.	Percs slowly, large stones.
Coweta part	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Not needed	Depth to rock, rooting depth, slope.	Droughty, rooting depth, slope.
Stephenville: [1]59: Stephenville part	Severe: depth to rock.	Moderate: thin layer.	Severe: no water.	Not needed	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
Stephenville:						
Darnell part	Severe: depth to rock, seepage.	Severe: thin layer.	Severe: no water.	Not needed	Depth to rock, erodes easily.	Rooting depth.
Stoneburg:						
[1]60:						
Stoneburg part	Severe: depth to rock.	Moderate: thin layer.	Severe: no water.	Not needed	Favorable	Favorable.
Lucien part	Severe: depth to rock, seepage.	Severe: thin layer.	Severe: no water.	Not needed	Not needed	Not needed.
Summit:						
61	Slight	Severe: compressible, piping.	Severe: slow refill.	Percs slowly	Percs slowly, wetness.	Percs slowly, wetness.
[1]62:						
Summit part	Slight	Severe: compressible, piping.	Severe: slow refill.	Percs slowly	Percs slowly, wetness.	Percs slowly, wetness.
Shidler part	Severe: depth to rock.	Severe: depth to rock, large stones.	Severe: no water.	Not needed	Depth to rock, large stones.	Rooting depth, large stones.
Teller:						
63	Severe: seepage.	Moderate: unstable fill, piping.	Severe: no water.	Not needed	Erodes easily, piping.	Erodes easily.
Vanoss:						
64, 65	Moderate: seepage.	Moderate: unstable fill, low strength, piping.	Severe: no water.	Not needed	Favorable	Favorable.
Verdigris:						
66, [1]67	Moderate: seepage.	Moderate: low strength, piping.	Severe: deep to water.	Floods	Floods	Favorable.
Wolco:						
68	Moderate: depth to rock.	Moderate: depth to rock, unstable fill, compressible.	Severe: slow refill.	Depth to rock, percs slowly.	Percs slowly, depth to rock.	Percs slowly.
[1]69:						
Wolco part	Moderate: depth to rock.	Moderate: depth to rock, unstable fill, compressible.	Severe: slow refill.	Depth to rock, percs slowly.	Percs slowly, depth to rock.	Percs slowly.
Dwight part	Moderate: depth to rock.	Moderate: shrink-swell, low strength.	Severe: no water.	Favorable	Percs slowly	Percs slowly, excess sodium, excess salt.
Wynona:						
70	Slight	Moderate: compressible, unstable fill.	Severe: slow refill.	Floods, percs slowly.	Not needed	Wetness.

[1]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 15.—ENGINEERING PROPERTIES AND CLASSIFICATIONS

[The symbol < means less than; > means greater than. Absence of an entry means data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number—				Liquid limit	Plasticity index
			Unified	AASHTO	> 3 inches	4	10	40	200		
	In				Pct					Pct	
Apperson:											
1	0-9	Silty clay loam	CL, ML	A-6, A-7	0	100	100	95-100	75-98	33-44	12-20
	9-17	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	95-100	80-99	41-70	20-40
	17-50	Silty clay	CL, CH	A-7	0	85-100	83-100	80-100	75-99	41-70	20-40
	50-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
[1]2:											
Apperson part	0-12	Silty clay loam	CL, ML	A-6, A-7	0	100	100	95-100	75-98	33-44	12-20
	12-16	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	95-100	80-99	41-70	20-40
	16-46	Silty clay	CL, CH	A-7	0	85-100	83-100	80-100	75-99	41-70	20-40
	46-48	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Dwight part	0-5	Silt loam	CL-ML, CL	A-4, A-6	0	100	100	95-100	85-100	25-40	5-15
	5-26	Silty clay	CH	A-7	0	100	100	95-100	90-100	50-65	25-45
	26-50	Silty clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	90-100	45-60	25-40
	50-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Barnsdall:											
3	0-11	Very fine sandy loam.	CL, ML, CL-ML	A-4	0	100	100	94-100	51-97	<30	[2]NP-10
	11-58	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	96-100	80-98	33-43	12-20
	58-72	Fine sandy loam, loam, clay loam.	CL, ML, SC, SM	A-4, A-6	0	100	98-100	94-100	36-90	<35	NP-15
Bates:											
4, 5	0-10	Loam	ML, CL	A-4	0	100	100	90-100	55-90	20-40	3-15
	10-36	Loam, clay loam, sandy clay loam.	ML, CL	A-4, A-6	0	100	100	90-100	50-85	25-40	3-20
	36-40	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Catoosa:											
[1]6:											
Catoosa part	0-9	Silt loam	ML, CL	A-4, A-6	0	100	100	96-100	80-97	30-37	9-13
	9-13	Silt loam, silty clay loam.	ML, CL	A-4, A-6, A-7	0	100	100	96-100	80-98	30-43	9-20
	13-30	Silty clay loam	CL	A-6, A-7	0	100	100	96-100	90-98	33-43	12-20
	30-32	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Shidler part	0-8	Silt loam, silty clay loam.	CL, ML	A-4, A-6	0	90-100	90-100	90-100	80-98	30-37	8-13
	8-10	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Choska:											
7	0-9	Very fine sandy loam.	CL, ML, CL-ML	A-4	0	100	100	94-100	51-97	<31	NP-10
	9-40	Silt loam, very fine sandy loam.	CL, ML, CL-ML	A-4	0	100	100	94-100	51-97	<31	NP-9
	40-65	Silt loam, very fine sandy loam.	CL, ML, CL-ML	A-4	0	100	100	94-100	51-97	<31	NP-9

See footnotes at end of table.

TABLE 15.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	> 3 inches	4	10	40	200		
	In				Pct					Pct	
Cleora:											
8, 9	0-12	Fine sandy loam	SM, SC, ML, CL	A-4	0	100	98-100	94-100	36-60	<31	NP-10
	12-25	Loam, fine sandy loam.	SM, SC, ML, CL	A-4, A-2	0	100	98-100	94-100	29-85	<31	NP-10
	25-60	Fine sandy loam, loamy fine sand.	SM, SC, ML, CL	A-2, A-4	0	100	98-100	90-100	15-60	<31	NP-10
Corbin:											
10, 11	0-14	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	75-100	25-35	5-15
	14-27	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-100	35-45	10-25
	27-63	Silty clay, silty clay loam.	CH, CL	A-7-6	0	100	100	95-100	90-100	45-60	25-35
	63-81	Silty clay loam, silty clay.	CL	A-6, A-7	0	100	100	95-100	85-100	35-45	12-25
[1]12:											
Corbin part	0-14	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	75-100	25-35	5-15
	14-27	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-100	35-45	10-25
	27-63	Silty clay, silty clay loam.	CH, CL	A-7-6	0	100	100	95-100	90-100	45-60	25-35
	63-81	Silty clay loam, silty clay.	CL	A-6, A-7	0	100	100	95-100	85-100	35-45	12-25
Pawhuska part	0-3	Silt loam	ML, CL-ML	A-4	0	100	100	96-100	80-97	22-30	2-7
	3-80	Silty clay loam, silty clay.	CL, CH	A-7	0	90-100	90-100	85-100	85-99	41-70	20-40
Coweta:											
[1]13:											
Coweta part	0-9	Loam	ML, CL, SM, SC	A-4	0-30	70-100	70-100	60-100	36-85	<31	NP-10
	9-16	Fine sandy loam, loam.	ML, CL, SM, SC	A-6, A-4	0-25	55-75	55-75	45-70	36-65	<31	NP-12
	16-20	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Bates part	0-10	Loam	ML, CL	A-4, A-6	0	100	100	90-100	55-90	20-40	3-15
	10-36	Loam, clay loam, sandy clay loam.	ML, CL	A-4, A-6	0	100	100	90-100	50-85	25-40	3-30
	36-40	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Darnell:											
[1]14:											
Darnell part	0-4	Fine sandy loam	SM, SC, ML, CL	A-4	0-5	90-100	90-100	85-100	36-60	<30	NP-10
	4-12	Fine sandy loam	SM, SC, ML, CL	A-4	0-8	70-100	70-100	60-100	36-60	<30	NP-10
	12-14	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Stephenville part	0-8	Fine sandy loam	SM, SC, ML, CL	A-4	0	100	98-100	94-100	36-60	<30	NP-10
	8-26	Fine sandy loam, sandy clay loam.	SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	25-37	7-16
	26-30	Weathered bedrock.	---	---	---	---	---	---	---	---	---

See footnotes at end of table.

TABLE 15.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	> 3 inches	4	10	40	200		
	In				Pct					Pct	
Dennis:											
15, 16	0-13	Silt loam	ML, CL, CL-ML	A-4, A-6	0	100	100	96-100	80-97	20-37	1-15
	13-20	Silty clay loam	CL	A-6, A-7	0	98-100	98-100	94-100	75-98	33-48	13-25
	20-62	Silty clay, silty clay loam.	CL, CH, ML, MH	A-7, A-6	0	98-100	98-100	94-100	75-98	37-65	15-35
[1]17:											
Dennis part	0-9	Silt loam	ML, CL, CL-ML	A-4, A-6	0	100	100	96-100	80-97	20-37	1-15
	9-72	Silty clay, silty clay loam.	CL, CH, ML, MH	A-7, A-6	0	98-100	98-100	94-100	75-98	37-65	15-35
Carytown part	0-9	Silt loam	CL-ML, CL	A-4, A-6	0	100	95-100	95-100	80-95	20-30	5-15
	9-72	Clay, silty clay, silty clay loam.	CH	A-7	0	100	95-100	90-100	90-100	51-70	30-45
[1]18:											
Dennis part	0-10	Silt loam	ML, CL, CL-ML	A-4, A-6	0	100	100	96-100	80-97	20-37	1-15
	10-16	Silty clay loam	CL	A-6, A-7	0	98-100	98-100	94-100	75-98	33-48	13-25
	16-72	Silty clay, silty clay loam.	CL, CH, ML, MH	A-7, A-6	0	98-100	98-100	94-100	75-98	37-65	15-35
Verdigris part	0-19	Silt loam	ML, CL	A-4, A-6	0	100	100	96-100	80-98	30-37	8-13
	19-60	Silt loam, silty clay loam, clay loam.	ML, CL	A-4, A-6, A-7	0	100	100	96-100	80-98	30-45	8-25
Dougherty:											
19, 20	0-24	Loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	98-100	82-100	5-35	---	NP
	24-36	Sandy clay loam	CL, SC	A-4, A-6	0	100	98-100	90-100	36-65	25-37	7-16
	36-55	Fine sandy loam, sandy clay loam.	SM, ML, CL, SC	A-4, A-6	0	100	98-100	90-100	36-65	<37	NP-16
	55-62	Loamy fine sand	SM	A-2	0	100	98-100	90-100	15-35	---	NP
Eufaula:											
21	0-72	Loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	98-100	82-100	5-35	---	NP
[1]22:											
Eufaula part	0-72	Loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	98-100	82-100	5-35	---	NP
Dougherty part	0-38	Loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	98-100	82-100	5-35	---	NP
	38-52	Sandy clay loam	CL, SC	A-4, A-6	0	100	98-100	90-100	36-65	25-37	7-16
	52-72	Loamy fine sand	SM	A-2	0	100	98-100	90-100	15-35	---	NP
Foraker:											
[1]23:											
Foraker part	0-11	Silty clay loam	CL	A-6, A-7	0-65	55-100	55-100	55-98	50-98	37-50	15-25
	11-26	Silty clay, silty clay loam.	CL, CH	A-7	0	75-100	75-100	70-100	70-98	41-70	20-40
	26-38	Silty clay, silty clay loam, shaly silty clay.	CL, CH, GC, SC	A-2, A-7	0	15-90	15-90	15-85	14-85	41-70	20-40
	38-48	Weathered bedrock.	---	---	---	---	---	---	---	---	---

See footnotes at end of table.

TABLE 15.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Foraker:											
Shidler part-----	0-8	Silty clay loam, silt loam.	CL	A-6, A-7	0	90-100	90-100	90-100	80-98	33-42	12-19
	8-10	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Gasil:											
24----------	0-14	Fine sandy loam	CL, ML, SC, SM	A-4	0	95-100	92-100	85-99	36-55	20-28	3-10
	14-74	Sandy clay loam	CL, SC, CL-ML, SM-SC	A-6, A-4	0	95-100	92-100	85-100	36-71	22-40	7-20
Grainola:											
[1]25:											
Grainola part----	0-8	Silty clay loam	CL, SC, GC	A-6, A-7	0-55	40-95	40-95	40-95	36-90	37-50	15-25
	8-13	Silty clay loam, silty clay.	CL, CH	A-7	0-15	75-90	75-90	75-90	70-90	41-70	20-40
	13-28	Silty clay, silty clay loam.	CL, CH	A-7	0	75-100	75-100	75-98	73-98	41-70	20-40
	28-36	Silty clay, silty clay loam.	CL, CH, SC, GC	A-2, A-7	0	20-90	20-90	20-85	18-85	41-70	20-40
	36-42	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Shidler part-----	0-8	Silty clay loam, silt loam.	CL	A-6, A-7	0	90-100	90-100	90-100	80-98	33-42	12-19
	8-10	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Klomatia:											
26, [1]27----------	0-17	Loamy fine sand, fine sandy loam, very fine sandy loam.	SM	A-4, A-2	0	100	95-100	80-100	30-45	<26	NP-4
	17-65	Stratified loamy fine sand.	SM	A-2	0	100	95-100	80-90	13-35	<22	NP-4
Konawa:											
28----------	0-15	Loamy fine sand	SM	A-2	0	98-100	98-100	85-100	15-35	---	NP
	15-30	Sandy clay loam	SC, CL	A-4, A-6	0	98-100	98-100	85-100	40-60	26-40	8-18
	30-43	Fine sandy loam, sandy clay loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0	98-100	98-100	85-100	40-60	<34	4-14
	43-62	Loamy fine sand, fine sandy loam.	SM, ML, SM-SC, CL-ML	A-2	0	98-100	98-100	85-100	15-60	<26	NP
Lightning:											
29----------	0-10	Silt loam, silty clay loam.	CL	A-4, A-6	0	100	100	95-100	85-98	30-40	8-19
	10-72	Silty clay loam, silty clay.	CL, CH, MH	A-6, A-7	0	100	100	96-100	90-99	37-70	15-40
Lula:											
30----------	0-10	Silt loam-------	CL, ML	A-4, A-6	0	100	100	96-100	80-97	21-37	1-15
	10-18	Silty clay loam, silt loam.	CL, ML	A-6, A-4, A-7	0	100	100	96-100	80-98	30-43	9-20
	18-49	Silty clay loam	CL	A-6, A-7	0	95-100	95-100	96-100	80-98	33-50	12-26
	49-50	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnotes at end of table.

TABLE 15.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Mason:											
31, 32	0-13	Silt loam	ML, CL	A-4, A-6	0	100	100	96-100	80-98	20-35	1-13
	13-96	Silty clay loam, silt loam.	CL, ML	A-6, A-4, A-7	0	98-100	98-100	96-100	80-98	30-43	9-20
[1]33:											
Mason part	0-12	Silt loam	ML, CL	A-4, A-6	0	100	100	96-100	80-98	20-35	1-13
	12-86	Silty clay loam, silt loam.	CL, ML	A-6, A-4, A-7	0	98-100	98-100	96-100	80-98	30-43	9-20
Drummond part	0-5	Silt loam	CL, ML	A-4, A-6	0	100	100	96-100	80-97	30-37	8-13
	5-80	Silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	96-100	80-98	35-60	15-35
Minco:											
34	0-38	Silt loam, very fine sandy loam.	ML, CL, CL-ML	A-4	0	100	100	94-100	51-97	<31	NP-10
	38-62	Silt loam, very fine sandy loam.	ML, CL	A-4	0	100	98-100	94-100	51-97	<31	NP-10
Niotaze:											
[1]35:											
Niotaze part	0-6	Silt loam, fine sandy loam, very fine sandy loam, loam.	SM, SC, ML, CL	A-4, A-6	25-60	55-100	50-100	40-95	36-95	<35	NP-12
	6-36	Silty clay	CH, CL	A-7	0	95-100	95-100	90-100	90-100	41-75	15-41
	36-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Darnell part	0-4	Stony fine sandy loam.	SM, SC, ML, CL	A-4	5-25	90-100	90-100	85-100	36-60	<30	NP-10
	4-10	Fine sandy loam, loam.	SM, SC, ML, CL	A-4	0-8	70-100	70-100	60-100	36-60	<30	NP-10
	10-12	Weathered bedrock.	---	---	---	---	---	---	---	---	---
[1]36:											
Niotaze part	0-9	Silt loam, fine sandy loam, very fine sandy loam, loam.	SM, SC, ML, CL	A-4, A-6	25-60	55-100	50-100	40-95	36-95	<35	NP-12
	9-28	Silty clay	CH, CL	A-7	0	95-100	95-100	90-100	90-100	41-75	15-41
	28-32	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Darnell part	0-3	Stony fine sandy loam.	SM, SC, ML, CL	A-4	5-25	90-100	90-100	85-100	36-60	<30	NP-10
	3-10	Fine sandy loam, loam.	SM, SC, ML, CL	A-4	0-8	70-100	70-100	60-100	36-60	<30	NP-10
	10-12	Weathered bedrock.	---	---	---	---	---	---	---	---	---
[1]37:											
Niotaze part	0-7	Silt loam, fine sandy loam, very fine sandy loam, loam.	SM, SC, ML, CL	A-4, A-6	25-60	55-100	50-100	40-95	36-95	<35	NP-12
	7-20	Silty clay	CH, CL	A-7	0	95-100	95-100	90-100	90-100	41-75	15-41
	20-30	Weathered bedrock.	---	---	---	---	---	---	---	---	---

See footnotes at end of table.

TABLE 15.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	> 3 inches	4	10	40	200		
	In				Pct					Pct	
Niotaze:											
Darnell part-----	0-3	Stony fine sandy loam.	SM, SC, ML, CL	A-4	5-25	90-100	90-100	85-100	36-60	<30	NP-10
	3-11	Fine sandy loam, loam.	SM, SC, ML, CL	A-4	0-8	70-100	70-100	60-100	36-60	<30	NP-10
	11-13	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Norge:											
38, 39, 40, 41----	0-17	Silt loam, silty clay loam.	ML, CL	A-4, A-6	0	100	100	96-100	80-98	22-35	2-15
	17-65	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	96-100	75-98	33-43	12-20
[1]42:											
Norge part-------	0-11	Silt loam, silty clay loam.	ML, CL	A-4, A-6	0	100	100	96-100	80-98	22-35	2-15
	11-60	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	96-100	75-98	33-48	12-29
Dennis part------	0-13	Silt loam-------	ML, CL, CL-ML	A-4, A-6	0	100	100	96-100	80-97	20-37	1-15
	13-18	Silty clay loam	CL	A-6, A-7	0	98-100	98-100	94-100	75-98	33-48	13-25
	18-72	Silty clay, silty clay loam.	CL, CH, ML, MH	A-7, A-6	0	98-100	98-100	94-100	75-98	37-65	15-35
Prue part--------	0-13	Loam------------	CL, ML, CL-ML	A-4	0	100	100	96-100	65-85	22-31	3-10
	13-21	Loam, clay loam, sandy clay loam.	CL, SC	A-4, A-6	0	100	100	90-100	36-85	25-35	7-15
	21-42	Sandy clay loam, clay loam.	CL, SC	A-4, A-6	0	95-100	95-100	90-100	36-85	25-35	7-15
	42-72	Silty clay, silty clay loam.	CL, CH	A-6, A-7	0	70-100	70-100	65-100	65-99	35-60	15-35
[1]43:											
Norge part-------	0-15	Silt loam, silty clay loam.	ML, CL	A-4, A-6	0	100	100	96-100	80-98	22-35	2-15
	15-72	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	96-100	75-98	33-43	12-20
Pawhuska part----	0-8	Silt loam-------	ML, CL-ML	A-4	0	100	100	96-100	80-97	22-30	2-7
	8-72	Silty clay loam, silty clay.	CL, CH	A-7	0	90-100	90-100	85-100	85-99	41-70	20-40
Oil-waste land:											
44----------	---	----------	---	---	---	---	---	---	---	---	---
Okemah:											
45----------	0-21	Silt loam, silty clay loam.	CL, ML	A-4, A-6, A-7	0	98-100	98-100	96-100	80-98	20-47	1-23
	21-50	Silty clay, silty clay loam.	CL, CH, MH, ML	A-7	0	98-100	98-100	96-100	80-99	45-70	19-44
	50-71	Silty clay------	CL, CH, MH, ML	A-7	0	98-100	98-100	96-100	90-99	48-65	21-38
Osage:											
46----------	0-16	Silty clay------	CH	A-7	0	100	100	100	95-100	50-75	30-55
	16-72	Silty clay, clay	CH	A-7	0	100	100	100	95-100	50-80	30-55

See footnotes at end of table.

TABLE 15.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Parsons:											
47, 48	0-12	Silt loam	ML, CL, CL-ML	A-4, A-6	0	100	96-100	96-100	80-97	20-37	1-12
	12-70	Silty clay	CL, CH	A-6, A-7	0	100	96-100	96-100	80-99	37-70	15-40
	70-76	Weathered bedrock.	---	---	---	---	---	---	---	---	---
[1]49:											
Parsons part	0-13	Silt loam	ML, CL, CL-ML	A-4, A-6	0	100	96-100	96-100	80-97	20-37	1-12
	13-60	Silty clay	CL, CH	A-6, A-7	0	100	96-100	96-100	80-99	37-70	15-40
Carytown part	0-6	Silt loam	CL-ML, CL	A-4, A-6	0	100	95-100	95-100	80-95	20-30	5-15
	6-60	Clay, silty clay loam, silty clay.	CH	A-7	0	100	95-100	90-100	90-100	51-70	30-45
Pits:											
50	---	---	---	---	---	---	---	---	---	---	---
Prue:											
51	0-12	Loam	CL, ML, CL-ML	A-4	0	100	100	96-100	65-85	22-31	3-10
	12-18	Loam, clay loam, sandy clay loam.	CL, SC	A-4, A-6	0	100	100	90-100	36-85	25-35	7-15
	18-39	Sandy clay loam, clay loam.	CL, SC	A-4, A-6	0	95-100	95-100	90-100	36-85	25-35	7-15
	39-72	Silty clay, silty clay loam.	CL, CH	A-6, A-7	0	70-100	70-100	65-100	65-99	35-60	15-35
	72-96	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Pursley Variant:											
52	0-6	Fine sandy loam	SM, ML, CL-ML	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	6-24	Fine sandy loam, loam, loamy fine sand.	SM, ML, CL-ML	A-2, A-4	0	100	98-100	90-100	15-65	<26	NP-7
	24-60	Stratified fine sand.	SM, SP-SM	A-2, A-3	0	100	98-100	82-98	5-25	---	NP
Roebuck:											
53	0-60	Silty clay loam, silty clay, clay loam.	CL, CH	A-6, A-7	0	100	100	96-100	90-99	37-70	15-40
Shidler:											
[1]54	0-7	Silty clay loam, silt loam.	CL, ML, CH	A-4, A-6, A-7	0-45	80-100	80-100	55-100	51-95	30-55	8-27
	7-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Steedman:											
55, 56	0-7	Silt loam	CL	A-4, A-6	0-5	75-100	75-100	70-100	60-98	30-37	8-14
	7-32	Clay, silty clay	CL, CH	A-7	0	98-100	95-100	95-100	90-99	41-70	20-40
	32-42	Weathered bedrock.	---	---	---	---	---	---	---	---	---
[1]57:											
Steedman part	0-8	Very stony silt loam.	CL	A-4, A-6	5-45	75-100	75-100	70-100	60-98	30-37	8-14
	8-28	Clay, silty clay	CL, CH	A-7	0	98-100	95-100	95-100	90-99	41-70	20-40
	28-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---

See footnotes at end of table.

TABLE 15.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	> 3 inches	4	10	40	200		
	In				Pct					Pct	
Steedman:											
157:											
Coweta part------	0-6	Loam----------	ML, CL, SM, SC	A-4	0-30	70-100	70-100	60-90	60-85	<31	NP-10
	6-12	Fine sandy loam, loam.	ML, CL, SM, SC	A-4, A-6	0-25	55-75	55-75	45-70	36-65	<31	NP-12
	12-14	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Steedman:											
158:											
Steedman part----	0-4	Very stony silt loam.	CL	A-4, A-6	5-45	75-100	75-100	70-100	60-98	30-37	8-14
	4-36	Clay, silty clay	CL, CH	A-7	0	98-100	95-100	95-100	90-99	41-70	20-40
	36-48	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Coweta part------	0-7	Loam----------	ML, CL, SM, SC	A-4	0-30	70-100	70-100	60-90	60-85	<31	NP-10
	7-11	Fine sandy loam, loam.	ML, CL, SM, SC	A-2, A-4, A-6	0-25	55-75	55-75	45-70	30-65	<31	NP-12
	11-15	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Stephenville:											
159:											
Stephenville part	0-14	Fine sandy loam	SM, SC, ML, CL	A-4	0	100	98-100	94-100	36-60	<30	NP-10
	14-30	Fine sandy loam, sandy clay loam.	SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	25-37	7-16
	30-36	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Darnell part-----	0-4	Fine sandy loam	SM, SC, ML, CL	A-4	0-5	90-100	90-100	85-100	36-60	<30	NP-10
	4-16	Fine sandy loam	SM, SC, ML, CL	A-4	0-8	70-100	70-100	60-100	36-60	<30	NP-10
	16-20	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Stoneburg:											
160:											
Stoneburg part---	0-10	Fine sandy loam	ML, SC, CL-ML, SM	A-4	0	95-100	95-100	85-100	40-75	<26	NP-7
	10-14	Fine sandy loam	CL-ML, ML	A-4	0	95-100	95-100	90-100	40-80	<26	NP-7
	14-23	Clay loam, sandy clay loam.	SC, CL	A-6, A-4	0	95-100	95-100	90-100	45-80	25-40	8-20
	23-27	Clay loam, sandy clay loam.	SC, CL	A-6, A-4	0-15	85-100	85-100	75-98	45-80	25-40	8-20
	27-30	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Lucien part------	0-7	Fine sandy loam	SM, SC, ML, CL	A-4	0-20	95-100	90-100	85-100	36-60	<31	NP-10
	7-18	Very fine sandy loam, fine sandy loam.	SM, SC, ML, CL	A-4	0-5	90-100	85-100	80-100	36-85	<31	NP-10
	18-20	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Summit:											
161----------	0-9	Silty clay loam	CL, ML	A-6, A-7	0	100	100	96-100	90-99	35-50	11-25
	9-17	Silty clay, silty clay loam.	CL, CH	A-7, A-6	0	100	100	96-100	90-99	37-65	15-35
	17-72	Silty clay------	CH, CL	A-7	0	98-100	98-100	96-100	90-98	41-70	18-40

See footnotes at end of table.

TABLE 15.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	> 3 inches	4	10	40	200		
	In				Pct					Pct	
Summit:											
[1]62:											
Summit part------	0-11	Silty clay loam	CL, ML	A-6, A-7	0	100	100	96-100	90-99	35-50	11-25
	11-18	Silty clay, silty clay loam.	CL, CH	A-7, A-6	0	100	100	96-100	90-99	37-65	15-35
	18-80	Silty clay------	CH, CL	A-7	0	98-100	98-100	96-100	90-98	41-70	18-40
Shidler part-----	0-8	Silt loam, silty clay loam.	CL, ML, CH	A-4, A-6, A-7	0-45	80-100	80-100	55-100	51-95	30-55	8-27
	8-11	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Teller:											
63----------	0-14	Loam----------	ML, CL	A-4	0	100	100	94-100	60-85	<30	NP-10
	14-52	Sandy clay loam, clay loam.	SC, CL	A-6, A-4	0	100	100	90-100	45-85	24-40	7-18
	52-60	Fine sandy loam, loam.	SM, SC, ML, CL	A-4, A-6	0	100	100	94-100	45-85	20-34	3-13
Vanoss:											
64, 65----------	0-12	Silt loam-------	ML, CL	A-4, A-6	0	100	100	96-100	80-95	22-37	2-14
	12-19	Silt loam, silty clay loam.	CL, ML	A-4, A-6, A-7	0	100	100	96-100	80-98	22-43	2-20
	19-56	Silty clay loam	CL	A-6, A-7	0	100	100	96-100	90-98	33-43	12-20
	56-72	Silty clay loam, clay loam.	CL	A-7, A-6	0	100	100	96-100	80-98	33-43	12-20
Verdigris:											
66, [1]67----------	0-21	Silt loam-------	ML, CL	A-4, A-6	0	100	100	96-100	80-98	30-37	8-13
	21-72	Silt loam, silty clay loam, clay loam.	ML, CL	A-4, A-6, A-7	0	100	100	96-100	80-98	30-45	8-25
Wolco:											
68----------	0-14	Silty clay loam	CL	A-6, A-7	0	100	100	96-100	80-98	30-42	11-20
	14-21	Silty clay loam	CL	A-6, A-7	0	100	100	98-100	90-98	33-42	12-20
	21-55	Silty clay loam, silty clay.	CL, CH	A-6, A-7	0-20	75-100	75-100	70-100	68-99	37-70	15-40
	55-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
[1]69:											
Wolco part-------	0-12	Silt loam-------	CL	A-6, A-7	0	100	100	96-100	80-98	30-42	11-20
	12-17	Silty clay loam	CL	A-6, A-7	0	100	100	98-100	90-98	33-42	12-20
	17-58	Silty clay loam, silty clay.	CL, CH	A-6, A-7	0-20	75-100	75-100	70-100	68-99	37-70	15-40
	58-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Dwight part------	0-5	Silt loam-------	CL-ML, CL	A-4, A-6	0	100	100	95-100	85-100	25-40	5-15
	5-30	Silty clay------	CH	A-7-6	0	100	100	95-100	90-100	50-65	25-45
	30-54	Silty clay, silty clay loam.	CL, CH	A-7-6	0	100	100	95-100	90-100	45-60	25-40
	54-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Wynona:											
70----------	0-35	Silty clay loam	CL	A-6, A-7	0	100	100	98-100	90-98	33-42	12-19
	35-63	Silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	98-100	90-99	33-55	12-30

[1]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

[2]NP=nonplastic.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[Dashes indicate data were not available. The symbol < means less than. The erosion tolerance factor (T) is for the entire profile. Absence of an entry means data were not estimated]

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T
	In	In/hr	In/in	pH	Mmhos/cm					
Apperson:										
1	0-9	0.2-0.6	0.16-0.20	5.6-6.5	<2	Moderate	High	Low	0.37	3
	9-17	0.2-0.6	0.10-0.20	5.6-7.8	<2	High	High	Low	0.37	
	17-50	0.06-0.2	0.10-0.15	6.1-8.4	<2	High	High	Low	0.32	
	50-60	---	---	---	---	---	---	---	---	
[1]2:										
Apperson part	0-12	0.2-0.6	0.16-0.20	5.6-6.5	<2	Moderate	High	Low	0.37	3
	12-16	0.2-0.6	0.10-0.20	5.6-7.8	<2	High	High	Low	0.37	
	16-46	0.06-0.2	0.10-0.15	6.1-8.4	<2	High	High	Low	0.32	
	46-48	---	---	---	---	---	---	---	---	
Dwight part	0-5	0.6-2.0	0.21-0.24	5.6-6.5	<2	Low	High	Low	0.49	2
	5-26	<0.06	0.05-0.10	6.1-8.4	<4	High	High	Moderate	0.49	
	26-50	0.06-0.6	0.05-0.10	7.4-8.4	<8	High	High	Moderate	0.49	
	50-60	---	---	---	---	---	---	---	---	
Barnsdall:										
3	0-11	0.6-2.0	0.13-0.20	5.6-7.3	<2	Low	Low	Moderate	0.37	5
	11-58	0.6-2.0	0.15-0.20	5.1-7.3	<2	Moderate	Moderate	Moderate	0.32	
	58-72	0.6-2.0	0.11-0.17	5.1-6.0	<2	Low	Moderate	Moderate	0.32	
Bates:										
4, 5	0-16	0.6-2.0	0.15-0.20	5.6-6.5	<2	Low	Low	Moderate	0.28	3-2
	16-36	0.6-2.0	0.15-0.19	5.1-6.5	<2	Moderate	Low	Moderate	0.28	
	36-40	---	---	---	---	---	---	---	---	
Catoosa:										
[1]6:										
Catoosa part	0-9	0.60-2.0	0.15-0.24	5.6-6.5	<2	Low	Low	Moderate	0.32	2
	9-13	0.60-2.0	0.15-0.24	5.6-6.5	<2	Moderate	Moderate	Moderate	---	
	13-30	0.60-2.0	0.15-0.22	5.6-7.3	<2	Moderate	Moderate	Moderate	---	
	30-32	---	---	---	---	---	---	---	---	---
Shidler part	0-8	0.6-2.0	0.16-0.24	5.6-7.8	<2	Low	Moderate	Low	0.37	1
	8-10	---	---	---	---	---	---	---	---	
Choska:										
7	0-9	0.6-2.0	0.13-0.20	6.1-7.3	<2	Low	Low	Low	---	---
	9-40	0.6-2.0	0.13-0.24	6.6-8.4	<2	Low	Low	Low	---	
	40-65	2.0-6.0	0.13-0.24	6.6-8.4	---	Low	Low	Low	---	
Cleora:										
8, 9	0-12	2.0-6.0	0.11-0.15	5.6-7.3	<2	Low	Low	Moderate	---	---
	12-25	2.0-6.0	0.11-0.16	5.6-7.3	<2	Low	Low	Moderate	---	
	25-60	2.0-6.0	0.07-0.15	5.6-7.3	<2	Low	Low	Moderate	---	
Corbin:										
10, 11	0-14	0.6-2.0	0.19-0.24	5.6-6.5	<2	Low	Low	Low	0.37	5
	14-27	0.6-2.0	0.18-0.20	5.6-6.5	<2	Moderate	Low	Low	0.37	
	27-63	0.06-0.2	0.09-0.16	6.1-7.8	<2	High	High	Low	0.37	
	63-81	0.2-2.0	0.11-0.18	6.1-8.4	<2	Moderate	Moderate	Low	0.37	
[1]12:										
Corbin part	0-14	0.6-2.0	0.19-0.24	5.6-6.5	<2	Low	Low	Low	0.37	5
	14-27	0.6-2.0	0.18-0.20	5.6-6.5	<2	Moderate	Low	Low	0.37	
	27-63	0.06-0.2	0.09-0.16	6.1-7.8	<2	High	High	Low	0.37	
	63-81	0.2-2.0	0.11-0.18	6.1-8.4	<2	Moderate	Moderate	Low	0.37	
Pawhuska part	0-3	0.6-2.0	0.12-0.18	5.6-6.5	<2	Low	High	High	0.49	1
	3-80	<0.06	0.08-0.10	6.1-8.4	2-8	High	High	High	0.43	

See footnote at end of table.

TABLE 16.—PHYSICAL AND CHEMICAL PROPERTIES OF SOILS—Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T
	In	In/hr	In/in	pH	Mmhos/cm					
Coweta:										
[1]13:										
Coweta part	0-9	2.0-6.0	0.09-0.16	5.6-6.5	<2	Low	Low	Moderate	0.24	2
	9-16	0.6-2.0	0.09-0.18	5.6-6.5	<2	Low	Low	Moderate	0.24	
	16-20	---	---	---	---	---	---	---	---	
Bates part	0-16	0.6-2.0	0.15-0.20	5.6-6.5	<2	Low	Low	Moderate	0.28	3-2
	16-36	0.6-2.0	0.15-0.19	5.1-6.5	<2	Moderate	Low	Moderate	0.28	
	36-40	---	---	---	---	---	---	---	---	
Darnell:										
[1]14:										
Darnell part	0-4	2.0-6.0	0.12-0.16	5.6-6.5	<2	Low	Low	Moderate	0.24	2
	4-12	2.0-6.0	0.12-0.16	5.1-6.0	<2	Low	Low	Moderate	---	
	12-14	---	---	---	---	---	---	---	---	
Stephenville part	0-8	2.0-6.0	0.11-0.15	5.1-6.5	<2	Low	Low	Moderate	---	---
	8-26	0.6-2.0	0.11-0.17	5.1-6.0	<2	Low	Moderate	Moderate	---	
	26-30	---	---	---	---	---	---	---	---	
Dennis:										
15, 16	0-13	0.6-2.0	0.15-0.20	5.6-6.0	<2	Low	Low	Moderate	0.37	5
	13-20	0.2-0.6	0.15-0.20	5.6-6.0	<2	Moderate	Moderate	Moderate	---	
	20-62	0.06-0.2	0.15-0.20	5.6-6.5	<2	High	High	Moderate	---	
[1]17:										
Dennis part	0-9	0.6-2.0	0.15-0.20	5.6-6.0	<2	Low	Low	Moderate	0.37	5
	9-72	0.06-0.2	0.15-0.20	5.6-6.5	<2	High	High	Moderate	---	
Carytown part	0-9	0.6-2.0	0.19-0.24	5.6-6.5	<2	Low	High	Moderate	---	---
	9-72	<0.06	0.08-0.11	5.6-8.4	2-8	High	High	Low	---	
[1]18:										
Dennis part	0-10	0.6-2.0	0.15-0.20	5.6-6.0	<2	Low	Low	Moderate	0.37	5
	10-16	0.2-0.6	0.15-0.20	5.6-6.0	<2	Moderate	Moderate	Moderate	---	
	16-72	0.06-0.2	0.15-0.20	5.6-6.5	<2	High	High	Moderate	---	
Verdigris part	0-19	0.6-2.0	0.22-0.24	5.6-7.3	<2	Moderate	Low	Low	---	---
	19-60	0.6-2.0	0.17-0.22	5.6-7.3	<2	Moderate	Low	Low	---	
Dougherty:										
19, 20	0-24	2.0-6.0	0.05-0.11	5.6-6.5	<2	Low	Low	Moderate	0.20	5
	24-36	0.6-2.0	0.11-0.17	5.1-6.0	<2	Low	Low	Moderate	---	
	36-55	0.6-2.0	0.11-0.17	5.1-6.5	<2	Low	Low	Moderate	---	
	55-62	2.0-6.0	0.07-0.11	5.6-7.3	<2	Low	Low	Moderate	---	
Eufaula:										
21	0-72	6.0-20.0	0.05-0.11	5.1-7.3	<2	Low	Low	Moderate	0.17	5
[1]22:										
Eufaula part	0-72	6.0-20.0	0.05-0.11	5.1-7.3	<2	Low	Low	Moderate	0.17	5
Dougherty part	0-38	2.0-6.0	0.05-0.11	5.6-6.5	<2	Low	Low	Moderate	0.20	5
	38-52	0.6-2.0	0.11-0.17	5.1-6.0	<2	Low	Low	Moderate	---	
	52-72	2.0-6.0	0.07-0.11	5.6-7.3	<2	Low	Low	Moderate	---	
Foraker:										
[1]23:										
Foraker part	0-11	0.2-0.6	0.10-0.20	7.4-8.4	<2	Moderate	High	Low	0.37	3
	11-26	0.06-0.2	0.10-0.18	7.9-8.4	<2	High	High	Low	0.32	
	26-38	0.06-0.2	0.05-0.18	7.9-8.4	<2	High	High	Low	---	
	38-48	---	---	---	---	---	---	---	---	
Shidler part	0-8	0.6-2.0	0.18-0.22	5.6-7.8	<2	Moderate	Moderate	Low	0.32	1
	8-10	---	---	---	---	---	---	---	---	

See footnote at end of table.

TABLE 16.—PHYSICAL AND CHEMICAL PROPERTIES OF SOILS—Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T
	In	In/hr	In/in	pH	Mmhos/cm					
Gasil:										
24	0-14	2.0-6.0	0.11-0.15	5.6-6.5	<2	Low	Low	Low	0.24	5
	14-74	0.6-2.0	0.12-0.19	5.1-6.0	<2	Moderate	Low	Moderate	---	
Grainola:										
[1]25:										
Grainola part	0-8	0.2-0.6	0.10-0.20	7.9-8.4	<2	Moderate	High	Low	0.37	3
	8-13	0.06-0.2	0.10-0.20	7.9-8.4	<2	High	High	Low	0.32	
	13-28	0.06-0.2	0.10-0.16	7.9-8.4	<2	High	High	Low	---	
	28-36	0.06-0.2	0.05-0.18	7.9-8.4	<2	High	High	Low	---	
	36-42	---	---	---	---	---	---	---	---	
Shidler part	0-8	0.6-2.0	0.18-0.22	5.6-7.8	<2	Moderate	Moderate	Low	0.32	1
	8-10	---	---	---	---	---	---	---	---	
Kiomatia:										
26, [1]27	0-17	0.6-2.0	0.10-0.15	6.1-8.4	<2	Low	Low	Low	0.17	5
	17-65	6.0-20	0.05-0.10	6.1-8.4	<2	Low	Low	Low	0.17	
Konawa:										
28	0-15	6.0-20.0	0.06-0.10	5.6-6.5	<2	Low	Low	Moderate	0.17	5
	15-30	0.6-2.0	0.12-0.16	5.6-6.5	<2	Low	Moderate	Moderate	---	
	30-43	2.0-6.0	0.11-0.15	5.6-6.5	<2	Low	Low	Moderate	---	
	43-62	2.0-20.0	0.07-0.11	5.6-6.5	<2	Low	Low	Moderate	---	
Lightning:										
29	0-10	0.06-0.6	0.16-0.20	5.6-7.3	<2	Moderate	High	Moderate	0.49	5
	10-72	<0.06	0.10-0.15	5.6-8.4	<2	High	High	Moderate	0.37	
Lula:										
30	0-10	0.6-2.0	0.16-0.20	5.6-6.5	<2	Low	Low	Moderate	0.32	3
	10-18	0.6-2.0	0.16-0.20	5.6-6.5	<2	Moderate	Moderate	Moderate	---	
	18-49	0.6-2.0	0.16-0.20	5.6-7.3	<2	Moderate	Moderate	Moderate	---	
	49-50	---	---	---	---	---	---	---	---	
Mason:										
31, 32	0-13	0.6-2.0	0.16-0.20	5.6-6.5	<2	Low	Low	Moderate	0.32	5
	13-96	0.2-0.6	0.16-0.20	5.6-6.5	<2	Moderate	Moderate	Moderate	---	
[1]33:										
Mason part	0-12	0.6-2.0	0.16-0.20	5.6-6.5	<2	Low	Low	Moderate	0.32	5
	12-86	0.2-0.6	0.16-0.20	5.6-6.5	<2	Moderate	Moderate	Moderate	---	
Drummond part	0-5	0.6-2.0	0.11-0.18	6.1-7.8	<4	Low	High	Low	0.43	3
	5-80	<0.06	0.05-0.10	6.6-9.0	2-8	High	High	High	0.37	
Minco:										
34	0-38	0.6-2.0	0.13-0.24	5.6-7.3	<2	Low	Low	Low	0.28	5
	38-62	0.6-2.0	0.11-0.24	6.1-7.3	<2	Low	Low	Low	---	
Niotaze:										
[1]35:										
Niotaze part	0-6	0.6-6.0	0.10-0.16	5.1-6.0	<2	Low	Moderate	Moderate	0.28	3
	6-36	0.06-0.2	0.10-0.15	4.5-5.5	<2	High	High	Moderate	0.32	
	36-60	---	---	---	---	---	---	---	---	
Darnell part	0-4	2.0-6.0	0.12-0.16	5.6-6.5	<2	Low	Low	Moderate	---	---
	4-10	2.0-6.0	0.12-0.16	5.1-6.0	<2	Low	Low	Moderate	---	
	10-12	---	---	---	---	---	---	---	---	
[1]36:										
Niotaze part	0-9	0.6-6.0	0.10-0.16	5.1-6.0	<2	Low	Moderate	Moderate	0.28	3
	9-28	0.06-0.2	0.10-0.15	4.5-5.5	<2	High	High	Moderate	0.32	
	28-32	---	---	---	---	---	---	---	---	
Darnell part	0-3	2.0-6.0	0.12-0.16	5.6-6.5	<2	Low	Low	Moderate	---	---
	3-10	2.0-6.0	0.12-0.16	5.1-6.0	<2	Low	Low	Moderate	---	
	10-12	---	---	---	---	---	---	---	---	

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T
	In	In/hr	In/in	pH	Mmhos/cm					
Niotaze:										
[1]37:										
Niotaze part	0-7	0.6-6.0	0.10-0.16	5.1-6.0	<2	Low	Moderate	Moderate	0.28	3
	7-20	0.06-0.2	0.10-0.15	4.5-5.5	<2	High	High	Moderate	0.32	
	20-30	---	---	---	---	---	---	---	---	---
Darnell part	0-3	2.0-6.0	0.12-0.16	5.6-6.5	<2	Low	Low	Moderate	---	---
	3-11	2.0-6.0	0.12-0.16	5.1-6.0	<2	Low	Low	Moderate	---	
	11-13	---	---	---	---	---	---	---	---	
Norge:										
38, 39, 40, 41	0-17	0.6-2.0	0.15-0.24	5.6-6.5	<2	Low	Moderate	Low	0.32	5
	17-65	0.2-0.6	0.15-0.22	5.6-7.3	<2	Moderate	Moderate	Low	---	
[1]42:										
Norge part	0-11	0.6-2.0	0.15-0.24	5.6-6.5	<2	Low	Moderate	Low	0.32	5
	11-60	0.2-0.6	0.15-0.22	5.6-7.3	<2	Moderate	Moderate	Low	---	
Dennis part	0-13	0.6-2.0	0.15-0.20	5.6-6.0	<2	Low	Low	Moderate	0.37	5
	13-18	0.2-0.6	0.15-0.20	5.6-6.0	<2	Moderate	Moderate	Moderate	---	
	18-72	0.06-0.2	0.15-0.20	5.6-6.5	<2	High	High	Moderate	---	
Prue part	0-13	0.6-2.0	0.15-0.20	5.6-6.5	<2	Low	Low	Moderate	0.37	5
	13-21	0.6-2.0	0.12-0.20	5.1-6.0	<2	Low	Moderate	Moderate	0.32	
	21-42	0.6-2.0	0.12-0.20	5.1-6.5	<2	Low	Moderate	Moderate	---	
	42-72	0.2-0.6	0.14-0.20	5.1-8.4	<2	High	High	Low	---	
[1]43:										
Norge part	0-15	0.6-2.0	0.15-0.24	5.6-6.5	<2	Low	Moderate	Low	0.32	5
	15-72	0.2-0.6	0.15-0.22	5.6-7.3	<2	Moderate	Moderate	Low	---	
Pawhuska part	0-8	0.6-2.0	0.12-0.18	5.6-6.5	<2	Low	High	High	0.49	1
	8-72	<0.06	0.05-0.10	6.1-8.4	2-8	High	High	High	0.43	
Oil-waste land:										
44	---	---	---	---	---	---	---	---	---	---
Okemah:										
45	0-21	0.2-2.0	0.16-0.20	5.6-6.5	<2	Low	Moderate	Moderate	0.37	5
	21-50	0.06-0.2	0.15-0.19	6.1-7.8	<2	High	High	Low	---	
	50-71	0.06-0.2	0.15-0.19	6.6-7.8	<2	High	High	Low	---	
Osage:										
46	0-16	<0.06	0.12-0.14	5.6-7.3	<2	Very high	High	Moderate	---	---
	16-72	<0.06	0.08-0.12	5.6-8.4	<2	Very high	High	Moderate	---	
Parsons:										
47, 48	0-12	0.6-2.0	0.16-0.24	5.6-6.5	<2	Low	High	Moderate	0.37	4
	12-70	<0.6	0.14-0.22	5.6-8.4	<2	High	High	Moderate	0.43	
	70-76	---	---	---	---	---	---	---	---	---
[1]49:										
Parsons part	0-13	0.6-2.0	0.16-0.24	5.6-6.5	<2	Low	High	Moderate	0.37	4
	13-60	<0.6	0.10-0.15	5.6-8.4	<2	High	High	Moderate	0.43	
Carytown part	0-6	0.6-2.0	0.19-0.24	5.6-6.5	<2	Low	High	Moderate	---	---
	6-60	<0.06	0.05-0.10	5.6-8.4	2-8	High	High	Low	---	
Pits:										
50	---	---	---	---	---	---	---	---	---	---
Prue:										
51	0-12	0.6-2.0	0.15-0.20	5.6-6.5	<2	Low	Low	Moderate	0.37	5
	12-18	0.6-2.0	0.12-0.20	5.1-6.0	<2	Low	Moderate	Moderate	0.32	
	18-39	0.6-2.0	0.12-0.20	5.1-6.5	<2	Low	Moderate	Moderate	---	
	39-72	0.2-0.6	0.14-0.20	5.1-8.4	<2	High	High	Low	---	
	72-96	---	---	---	---	---	---	---	---	

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T
	In	In/hr	In/in	pH	Mmhos/cm					
Pursley Variant:										
52	0-6	2.0-6.0	0.11-0.15	7.4-8.4	<2	Low	Low	Low	0.20	5
	6-24	2.0-6.0	0.07-0.18	6.6-8.4	<2	Low	Low	Low	0.32	
	24-60	2.0-20	0.05-0.08	6.1-7.3	<2	Low	Low	Low	0.15	
Roebuck:										
53	0-60	<0.06	0.10-0.15	5.6-8.4	<2	High	High	Low	0.37	5
Shidler:										
[1]54	0-7	0.6-2.0	0.12-0.22	5.6-7.8	<2	Low	Moderate	Low	0.32	1
	7-20	---	---	---	---	---	---	---	---	
Steedman:										
55, 56	0-7	0.6-2.0	0.15-0.20	5.6-6.5	<2	Low	Moderate	Moderate	0.37	3
	7-32	0.06-0.2	0.10-0.15	5.6-8.4	<2	High	High	Low	---	
	32-42	---	---	---	---	---	---	---	---	
[1]57:										
Steedman part	0-8	0.6-2.0	0.15-0.20	5.6-6.5	<2	Low	Moderate	Moderate	0.37	3
	8-28	0.06-0.2	0.10-0.15	5.6-8.4	<2	High	High	Low	---	
	28-60	---	---	---	---	---	---	---	---	
Coweta part	0-6	2.0-6.0	0.09-0.16	5.6-6.5	<2	Low	Low	Moderate	0.24	2
	6-12	0.6-2.0	0.09-0.18	5.6-6.5	<2	Low	Low	Moderate	0.24	
	12-14	---	---	---	---	---	---	---	---	
[1]58:										
Steedman part	0-4	0.6-2.0	0.15-0.20	5.6-6.5	<2	Low	Moderate	Moderate	0.37	3
	4-36	0.06-0.2	0.10-0.15	5.6-8.4	<2	High	High	Low	---	
	36-48	---	---	---	---	---	---	---	---	
Coweta part	0-7	2.0-6.0	0.09-0.16	5.6-6.5	<2	Low	Low	Moderate	0.24	2
	7-11	0.6-2.0	0.09-0.18	5.6-6.5	<2	Low	Low	Moderate	0.24	
	11-15	---	---	---	---	---	---	---	---	
Stephenville:										
[1]59:										
Stephenville part	0-14	2.0-6.0	0.11-0.15	5.1-6.5	<2	Low	Low	Moderate	---	---
	14-30	0.6-2.0	0.11-0.17	5.1-6.0	<2	Low	Moderate	Moderate	---	
	30-36	---	---	---	---	---	---	---	---	
Darnell part	0-4	2.0-6.0	0.12-0.16	5.6-6.5	<2	Low	Low	Moderate	0.24	2
	4-16	2.0-6.0	0.12-0.16	5.1-6.0	<2	Low	Low	Moderate	---	
	16-20	---	---	---	---	---	---	---	---	
Stoneburg:										
[1]60:										
Stoneburg part	0-10	2.0-6.0	0.11-0.20	5.6-6.5	<2	Low	Low	Low	0.24	2
	10-14	0.6-2.0	0.12-0.20	5.6-6.5	<2	Low	Moderate	Low	0.32	
	14-23	0.2-0.6	0.12-0.20	5.6-6.5	<2	Moderate	Moderate	Low	0.32	
	23-27	0.2-0.6	0.12-0.20	5.6-6.5	<2	Moderate	Moderate	Low	0.32	
	27-30	---	---	---	---	---	---	---	---	
Lucien part	0-7	2.0-6.0	0.10-0.15	5.6-6.5	<2	Low	Low	Low	0.24	2
	7-18	2.0-6.0	0.10-0.15	5.6-6.5	<2	Low	Low	Low	---	
	18-20	---	---	---	---	---	---	---	---	
Summit:										
61	0-9	0.2-0.6	0.16-0.20	5.6-6.5	<2	Moderate	High	Low	0.37	4
	9-17	0.2-0.6	0.10-0.18	5.6-6.5	<2	High	High	Low	0.32	
	17-72	0.06-0.2	0.10-0.18	6.1-8.4	<2	High	High	Low	0.32	
[1]62:										
Summit part	0-11	0.2-0.6	0.16-0.20	5.6-6.5	<2	Moderate	High	Low	0.37	4
	11-18	0.2-0.6	0.10-0.18	5.6-6.5	<2	High	High	Low	0.32	
	18-80	0.06-0.2	0.10-0.18	6.1-8.4	<2	High	High	Low	0.32	

See footnote at end of table.

TABLE 16.—PHYSICAL AND CHEMICAL PROPERTIES OF SOILS—Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T
	In	In/hr	In/in	pH	Mmhos/cm					
Summit:										
Shidler part	0-8	0.6-2.0	0.12-0.22	5.6-7.8	<2	Low	Moderate	Low	0.32	1
	8-11	---	---	---	---	---	---	---	---	
Teller:										
63	0-14	2.0-6.0	0.12-0.16	5.6-6.5	<2	Low	Low	Moderate	0.28	5
	14-52	0.6-2.0	0.14-0.18	5.6-6.5	<2	Low	Low	Moderate	---	
	52-60	2.0-6.0	0.13-0.17	5.6-7.3	<2	Low	Low	Moderate	---	
Vanoss:										
64, 65	0-12	0.6-2.0	0.15-0.20	5.6-6.5	<2	Low	Low	Low	0.32	5
	12-19	0.6-2.0	0.16-0.21	5.6-6.5	<2	Low	Low	Low	---	
	19-56	0.6-2.0	0.17-0.22	5.6-6.5	<2	Moderate	Moderate	Moderate	---	
	56-72	0.6-2.0	0.16-0.21	5.6-6.5	<2	Low	Moderate	Moderate	---	
Verdigris:										
66, [1]67	0-21	0.6-2.0	0.22-0.24	5.6-7.3	<2	Moderate	Low	Low	---	---
	21-72	0.6-2.0	0.17-0.22	5.6-7.3	<2	Moderate	Low	Low	---	
Wolco:										
68	0-14	0.2-2.0	0.16-0.24	5.6-6.5	<2	Moderate	Moderate	Moderate	0.37	3
	14-21	0.2-0.6	0.18-0.22	5.6-6.5	<2	Moderate	Moderate	Moderate	0.37	
	21-55	0.06-0.2	0.14-0.22	6.1-8.4	<2	High	High	Moderate	0.37	
	55-60	---	---	---	---	---	---	---	---	
[1]69:										
Wolco part	0-12	0.2-2.0	0.16-0.24	5.6-6.5	<2	Moderate	Moderate	Moderate	0.37	3
	12-17	0.2-0.6	0.18-0.22	5.6-6.5	<2	Moderate	Moderate	Moderate	0.37	
	17-58	0.06-0.2	0.14-0.22	6.1-8.4	<2	High	High	Moderate	0.37	
	58-60	---	---	---	---	---	---	---	---	
Dwight part	0-5	0.6-2.0	0.21-0.24	5.6-6.5	<2	Low	High	Low	0.49	2
	5-30	<0.06	0.05-0.10	5.6-8.4	<4	High	High	Moderate	0.49	
	30-54	0.06-0.6	0.05-0.10	7.4-8.4	<8	High	High	Moderate	0.49	
	54-60	---	---	---	---	---	---	---	---	
Wynona:										
70	0-35	0.2-0.6	0.18-0.22	5.1-6.5	<2	Moderate	High	Moderate	0.37	5
	35-63	0.06-0.2	0.14-0.20	5.1-6.0	<2	Moderate	High	Moderate	0.37	

[1]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 17.--SOIL AND WATER FEATURES

[Absence of an entry indicates the feature is not a concern. See text for descriptions of symbols. The symbol > means greater than]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness
					Ft			In	
Apperson:									
1	C	None	---	---	1.5-2.0	Perched	Dec-Apr	40-60	Hard
[1]2:									
Apperson part	C	None	---	---	1.5-2.0	Perched	Dec-Apr	40-60	Hard
Dwight part	D	None	---	---	>6.0	---	---	>40	Hard
Barnsdall:									
3	B	Rare	Very brief	Mar-Oct	>6.0	---	---	>60	---
Bates:									
4, 5	B	None	---	---	>6.0	---	---	20-40	Rippable
Catoosa:									
[1]6:									
Catoosa part	B	None	---	---	>6.0	---	---	20-40	Hard
Shidler part	D	None	---	---	>6.0	---	---	4-20	Hard
Choska:									
7	B	Occasional	Very brief	Mar-Oct	>6.0	---	---	>60	---
Cleora:									
8, 9	B	Occasional	Very brief	Mar-Oct	>6.0	---	---	>60	---
Corbin:									
10, 11	B	None	---	---	>6.0	---	---	>60	---
[1]12:									
Corbin part	B	None	---	---	>6.0	---	---	>60	---
Pawhuska part	D	None	---	---	>6.0	---	---	>60	---
Coweta:									
[1]13:									
Coweta part	C	None	---	---	>6.0	---	---	10-20	Rippable
Bates part	B	None	---	---	>6.0	---	---	20-40	Rippable
Darnell:									
[1]14:									
Darnell part	C	None	---	---	>6.0	---	---	10-20	Rippable
Stephenville part	B	None	---	---	>6.0	---	---	20-40	Rippable
Dennis:									
15, 16	C	None	---	---	2.0-3.0	Perched	Dec-Apr	>60	---
[1]17:									
Dennis part	C	None	---	---	2.0-3.0	Perched	Dec-Apr	>60	---
Carytown part	D	None	---	---	0-1.0	Perched	Dec-Apr	>60	---
[1]18:									
Dennis part	C	None	---	---	2.0-3.0	Perched	Dec-Apr	>60	---
Verdigris part	B	Frequent	Very brief	Mar-Oct	2.0-3.0	---	---	>60	---
Dougherty:									
19, 20	A	None	---	---	>6.0	---	---	>60	---

See footnote at end of table.

TABLE 17.—SOIL AND WATER FEATURES—Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness
					Ft			In	
Eufaula:									
21	A	None	---	---	>6.0	---	---	>60	---
[1]22:									
Eufaula part	A	None	---	---	>6.0	---	---	>60	---
Dougherty part	A	None	---	---	>6.0	---	---	>60	---
Foraker:									
[1]23:									
Foraker part	D	None	---	---	0.0-2.0	Perched	Nov-Apr	20-40	Rippable
Shidler part	D	None	---	---	>6.0	---	---	4-20	Hard
Gasil:									
24	B	None	---	---	>6.0	---	---	>60	---
Grainola:									
[1]25:									
Grainola part	D	None	---	---	>6.0	---	---	20-40	Rippable
Shidler part	D	None	---	---	>6.0	---	---	4-20	Hard
Kiomatia:									
26, [1]27	A	Rare to frequent.	Very brief to brief.	Mar-Oct	3.0-10.0	Apparent	Jan-Jul	>60	---
Konawa:									
28	B	None	---	---	>6.0	---	---	>60	---
Lightning:									
29	D	Occasional	Very brief	Mar-Oct	0-2.0	Perched	Nov-Apr	>60	---
Lula:									
30	B	None	---	---	>6.0	---	---	40-60	Hard
Mason:									
31, 32	B	Rare	Very brief	Mar-Oct	>6.0	---	---	>60	---
[1]33:									
Mason part	B	Rare	Very brief	Mar-Oct	>6.0	---	---	>60	---
Drummond part	D	Rare	Very brief	Mar-Oct	2.0-6.0	Apparent	Nov-Apr	>60	---
Minco:									
34	B	None	---	---	>6.0	---	---	>60	---
Niotaze:									
[1]35:									
Niotaze part	C	None	---	---	1.0-2.0	Perched	Mar-Jun	20-40	Rippable
Darnell part	C	None	---	---	>6.0	---	---	10-20	Rippable
[1]36:									
Niotaze part	C	None	---	---	1.0-2.0	Perched	Mar-Jun	20-40	Rippable
Darnell part	C	None	---	---	>6.0	---	---	10-20	Rippable
[1]37:									
Niotaze part	C	None	---	---	1.0-2.0	Perched	Mar-Jun	20-40	Rippable
Darnell part	C	None	---	---	>6.0	---	---	10-20	Rippable
Norge:									
38, 39, 40, 41	B	None	---	---	>6.0	---	---	>60	---
[1]42:									
Norge part	B	None	---	---	>6.0	---	---	>60	---

See footnote at end of table.

TABLE 17.—SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness
					Ft			In	
Norge:									
Dennis part	C	None	---	---	2.0-3.0	Perched	Dec-Apr	>60	---
Prue part	B	None	---	---	>6.0	---	---	>60	---
[1]43:									
Norge part	B	None	---	---	>6.0	---	---	>60	---
Pawhuska part	D	None	---	---	>6.0	---	---	>60	---
Oil-waste land: 44.									
Okemah: 45	C	None	---	---	2.0-3.0	Perched	Mar-Jun	>60	---
Osage: 46	D	Occasional	Brief	Mar-Oct	0-1.0	Perched	Nov-May	>60	---
Parsons: 47, 48	D	None	---	---	0.5-1.5	Perched	Dec-Apr	>60	---
[1]49:									
Parsons part	D	None	---	---	0.5-1.5	Perched	Dec-Apr	>60	---
Carytown part	D	None	---	---	0-1.0	Perched	Dec-Apr	>60	---
Pits: 50.									
Prue: 51	B	None	---	---	>6.0	---	---	>60	---
Pursley Variant: 52	B	Occasional	Very brief	Mar-Oct	>6.0	---	---	>60	---
Roebuck: 53	D	Occasional	Brief	Mar-Oct	>6.0	---	---	>60	---
Shidler: [1]54	D	None	---	---	>6.0	---	---	4-20	Hard
Steedman: 55, 56	D	None	---	---	0.5-1.0	Perched	Nov-Mar	20-40	Rippable
[1]57:									
Steedman part	D	None	---	---	0.5-1.0	Perched	Nov-Mar	20-40	Rippable
Coweta part	C	None	---	---	>6.0	---	---	10-20	Rippable
[1]58:									
Steedman part	D	None	---	---	0.5-1.0	Perched	Nov-Mar	20-40	Rippable
Coweta part	C	None	---	---	>6.0	---	---	10-20	Rippable
Stephenville: [1]59:									
Stephenville part	B	None	---	---	>6.0	---	---	20-40	Rippable
Darnell part	C	None	---	---	>6.0	---	---	10-20	Rippable
Stoneburg: [1]60:									
Stoneburg part	B	None	---	---	>6.0	---	---	20-40	Rippable

See footnote at end of table.

TABLE 17.—SOIL AND WATER FEATURES—Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness
					Ft			In	
Stoneburg:									
Lucien part	C	None	---	---	>6.0	---	---	10-20	Rippable
Summit:									
61	C	None	---	---	2.0-3.0	Perched	Dec-Apr	>60	---
[1]62:									
Summit part	C	None	---	---	2.0-3.0	Perched	Dec-Apr	>60	---
Shidler part	D	None	---	---	>6.0	---	---	4-20	Hard
Teller:									
63	B	None	---	---	>6.0	---	---	>60	---
Vanoss:									
64, 65	B	None	---	---	>6.0	---	---	>60	---
Verdigris:									
66, [1]67	B	Occasional to frequent.	Very brief	Mar-Oct	2.0-3.0	---	---	>60	---
Wolco:									
68	C	None	---	---	1.5-3.0	Perched	Dec-Apr	40-60	Hard
[1]69:									
Wolco part	C	None	---	---	1.5-3.0	Perched	Dec-Apr	40-60	Hard
Dwight part	D	None	---	---	>6.0	---	---	>40	Hard
Wynona:									
70	C	Occasional	Very brief	Mar-Oct	0-2.0	Perched	Nov-Apr	>60	---

[1]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 18.--ENGINEERING TEST DATA

[Tests performed by the Oklahoma Department of Highways in accordance with standard procedures of the American Association of State Highway and Transportation Officials (AASHTO)(1). Report number 515-1]

Soil name and location	Depth	Horizon	Shrinkage		Vol. change from field moisture equiv.	Mechanical analysis[1]									Liquid limit	Plasticity index	Classification	
						Percentage passing sieve--						Percentage smaller than--						
			Limit	Ratio		1-1/2 inch	1 inch	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05mm	0.005mm	0.002mm			AASHTO[2]	Unified[3]
Cleora fine sandy loam:																		
About 25 feet north of county road in the SW1/4 SE1/4SW1/4SE1/4 sec. 2, T. 23 N., R. 8 E.	6-12	A1	16	1.79	5	---	---	100	100	99	39	30	14	11	20	3	A-4(0)	SM
	12-25	C1	[4]NP	NP	NP	---	---	100	100	99	29	21	12	10	NP	NP	A-2-4(0)	SM
	25-53	C2	NP	NP	NP	---	---	100	100	98	28	23	12	10	NP	NP	A-2-4(0)	SM
Coweta loam:																		
About 25 feet east of county road in the NE1/4 NE1/4NE1/4 sec. 4, T. 20 N., R. 12 E.	0-11	A1	14	1.85	20	---	---	100	100	99	43	42	20	10	28	7	A-4(0)	SM-SC
Niotaze stony loam:																		
West side of road in the NE1/4NE1/4NW1/4SE1/4 sec. 27, T. 22 N., R. 4 E.	0-3	A1	22	1.65	14	---	100	95	90	86	76	65	25	19	35	12	A-6(8)	CL
	6-15	B21t	18	1.85	69	---	100	100	100	99	98	97	76	67	75	41	A-7-5(50)	CH
	21-28	B3	13	1.95	60	---	100	100	100	98	96	95	64	50	58	34	A-7-6(57)	CH
Shidler silty clay loam:																		
About 75 feet west of county road in the SE1/4 NE1/4NE1/4NE1/4NE1/4 sec. 13, T. 25 N., R. 8 E.	0-7	A1	12	1.93	57	---	---	100	100	100	95	89	44	36	52	26	A-7-6(29)	CH
Steadman flaggy silt loam:																		
North side of road in SE1/4SW1/4SW1/4 sec. 30 T. 24 N., R. 12 E.	0-8	A1	21	1.66	20	100	99	93	91	89	79	69	26	20	37	12	A-6(11)	ML
	8-17	B2t	16	1.85	57	100	100	100	100	100	97	94	60	49	53	25	A-7-6(29)	CH
	17-28	B3	13	1.95	54	100	100	100	100	99	98	95	53	42	48	24	A-7-6(29)	CL
Teller silt loam:																		
About 100 feet west of county road in NE1/4SE1/4 NE1/4SW1/4 sec. 4, T. 20 N., R. 4 E.	0-10	Ap	16	1.78	13	---	---	100	100	99	79	63	21	17	26	7	A-4(4)	CL-ML
	10-22	B2	24	1.58	13	---	---	100	100	99	82	69	27	24	29	23	A-4(1)	CL
	22-60	C	15	1.83	16	---	---	100	100	99	79	69	25	21	28	9	A-4(6)	CL

[1]Mechanical analysis according to AASHTO Designation T88-57(1). Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by the hydrometer method and the various grain-sized fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-sized fractions.

[2]Based on standard specifications for highway material and methods of sampling and testing: The classification of soils and soil-aggregate mixture for highway construction purposes, AASHTO designation M145-49(1). Oklahoma Department of Highways classification procedure further subdivides the AASHTO A-2-4 subgroup in the following: A-2-3(0) when PI = nonplastic; A-2(0) when PI = NP to 5; and A-2-4(0) when PI=5 to 10.

[3]Unified soil classification systems (2).
[4]NP=nonplastic.

TABLE 19.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates a taxadjunct to the series. See text for a description of those characteristics of this taxadjunct that are outside the range of the series]

Soil name	Family or higher taxonomic class
Apperson	Fine, montmorillonitic, thermic Vertic Argiudolls
Barnsdall	Fine-silty, mixed, thermic Ultic Hapludalfs
Bates	Fine-loamy, siliceous, thermic Typic Argiudolls
*Carytown	Fine, mixed, thermic Albic Natraqualfs
Catoosa	Fine-silty, mixed, thermic Typic Argiudolls
Choska	Coarse-silty, mixed, thermic Fluventic Hapludolls
Cleora	Coarse-loamy, mixed, thermic Fluventic Hapludolls
*Corbin	Fine-silty, mixed, thermic Pachic Argiustolls
Coweta	Loamy, siliceous, thermic, shallow Typic Hapludolls
Darnell	Loamy, siliceous, thermic, shallow Udic Ustochrepts
Dennis	Fine, mixed, thermic Aquic Paleudolls
Dougherty	Loamy, mixed, thermic Arenic Haplustalfs
*Drummond	Fine, mixed, thermic Mollic Natrustalfs
*Dwight	Fine, montmorillonitic, mesic Typic Natrustolls
Eufaula	Sandy, siliceous, thermic Psammentic Paleustalfs
Foraker	Fine, montmorillonitic, thermic Vertic Argiustolls
Gasil	Fine-loamy, siliceous, thermic Ultic Paleustalfs
Grainola	Fine, mixed, thermic Vertic Haplustalfs
*Kiomatia	Sandy, mixed, thermic Typic Udifluvents
*Konawa	Fine-loamy, mixed, thermic Ultic Haplustalfs
*Lightning	Fine, mixed, thermic Typic Ochraqualfs
Lucien	Loamy, mixed, thermic, shallow Typic Haplustolls
Lula	Fine-silty, mixed, thermic Typic Argiudolls
Mason	Fine-silty, mixed, thermic Typic Argiudolls
Minco	Coarse-silty, mixed, thermic Udic Haplustolls
Niotaze	Fine, montmorillonitic, thermic Aquic Paleustalfs
Norge	Fine-silty, mixed, thermic Udic Paleustolls
Okemah	Fine, mixed, thermic Aquic Paleudolls
Osage	Fine, montmorillonitic, thermic Vertic Haplaquolls
*Parsons	Fine, mixed, thermic Mollic Albaqualfs
Pawhuska	Fine, mixed, thermic Mollic Natrustalfs
Prue	Fine-loamy, siliceous, thermic Mollic Paleudalfs
Pursley Variant	Fine-loamy over sandy or sandy skeletal, mixed, thermic Fluventic Haplustolls
Roebuck	Fine, montmorillonitic, thermic Vertic Hapludolls
Shidler	Loamy, mixed, thermic Lithic Haplustolls
Steedman	Fine, montmorillonitic, thermic Vertic Haplustalfs
*Stephenville	Fine-loamy, siliceous, thermic Ultic Haplustalfs
Stoneburg	Fine-loamy, mixed, thermic Udic Argiustolls
Summit	Fine, montmorillonitic, thermic Vertic Argiudolls
Teller	Fine-loamy, mixed, thermic Udic Argiustolls
Vanoss	Fine-silty, mixed, thermic Udic Argiustolls
Verdigris	Fine-silty, mixed, thermic Cumulic Hapludolls
Wolco	Fine, mixed, thermic Pachic Argiustolls
Wynona	Fine-silty, mixed, thermic Cumulic Haplaquolls

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All Other Inquiries

For information not pertaining to civil rights, please refer to the listing of the USDA Agencies and Offices (http://directives.sc.egov.usda.gov/33086.wba).