United States
Department of
Agriculture

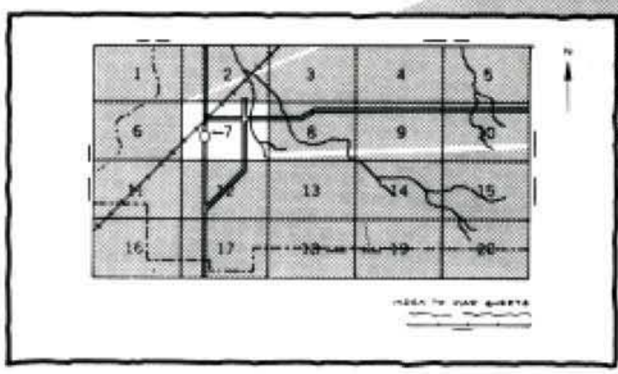
Soil
Conservation
Service

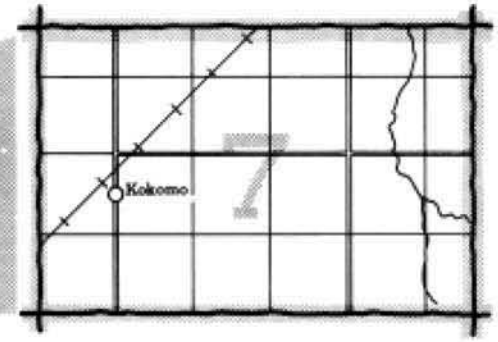
In cooperation with
the Oklahoma Agricultural
Experiment Station and
the Oklahoma Conservation
Commission

Soil Survey of Garvin County Oklahoma

HOW TO USE

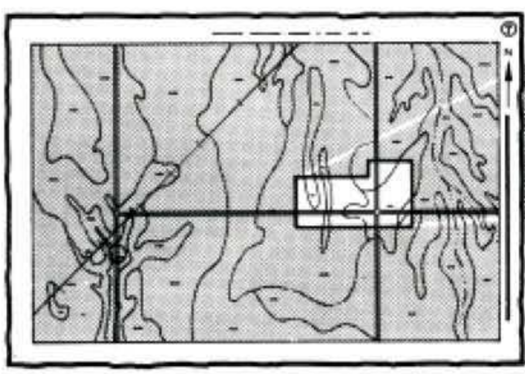
1. Locate your area of interest on the "Index to Map Sheets"

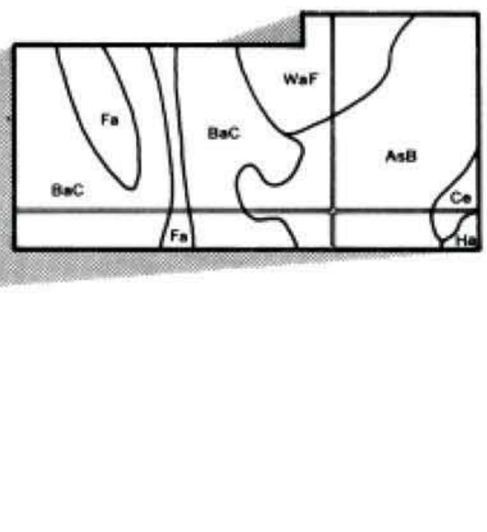




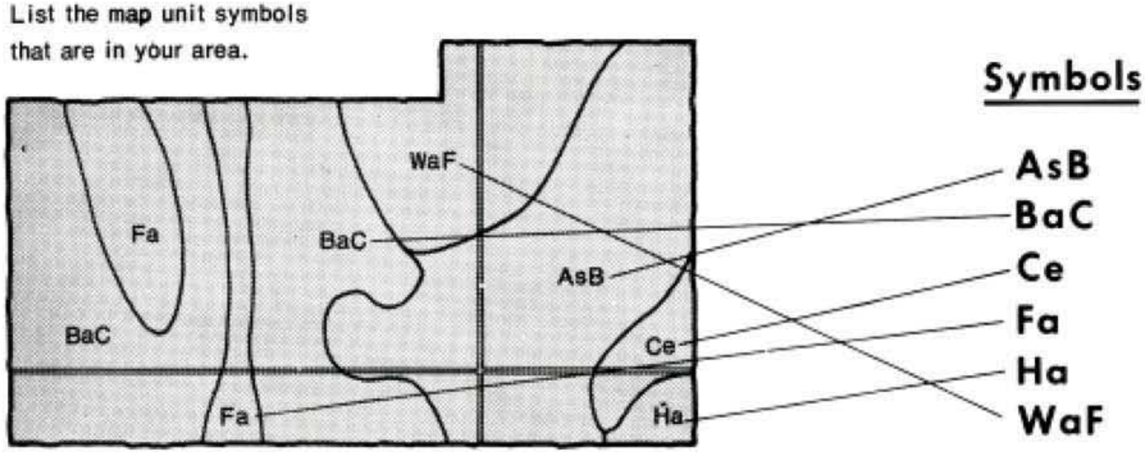
2. Note the number of the map sheet and turn to that sheet.

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



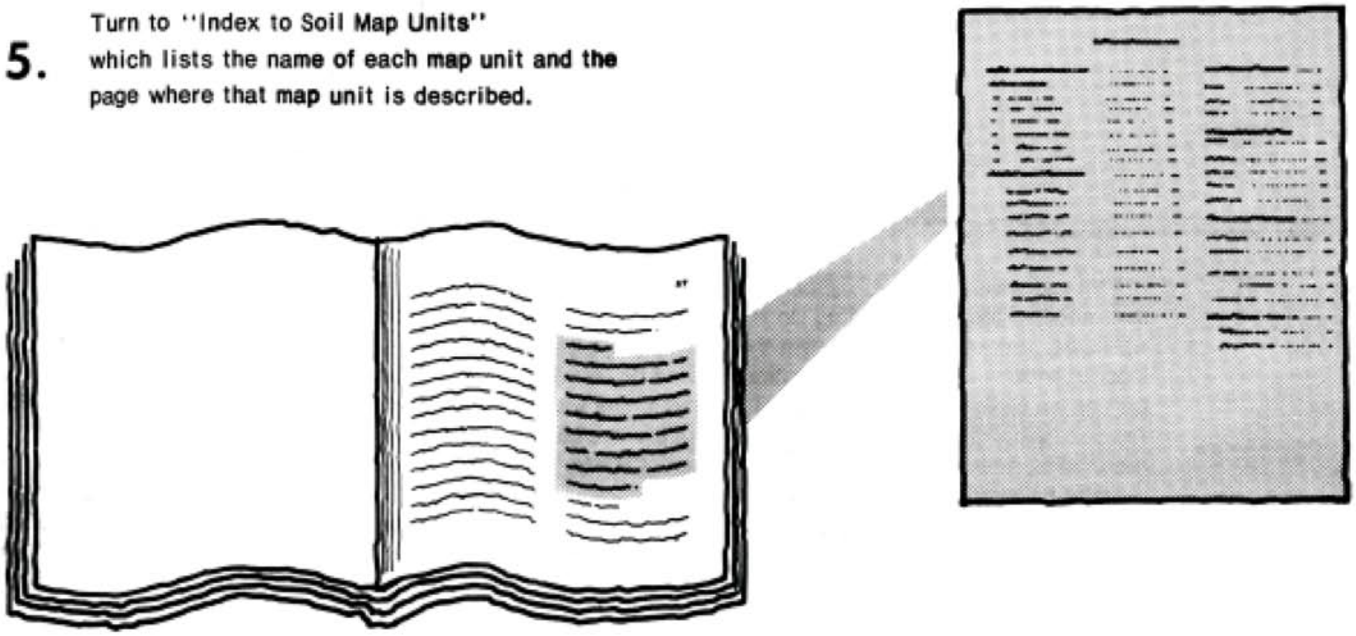


4. List the map unit symbols that are in your area.

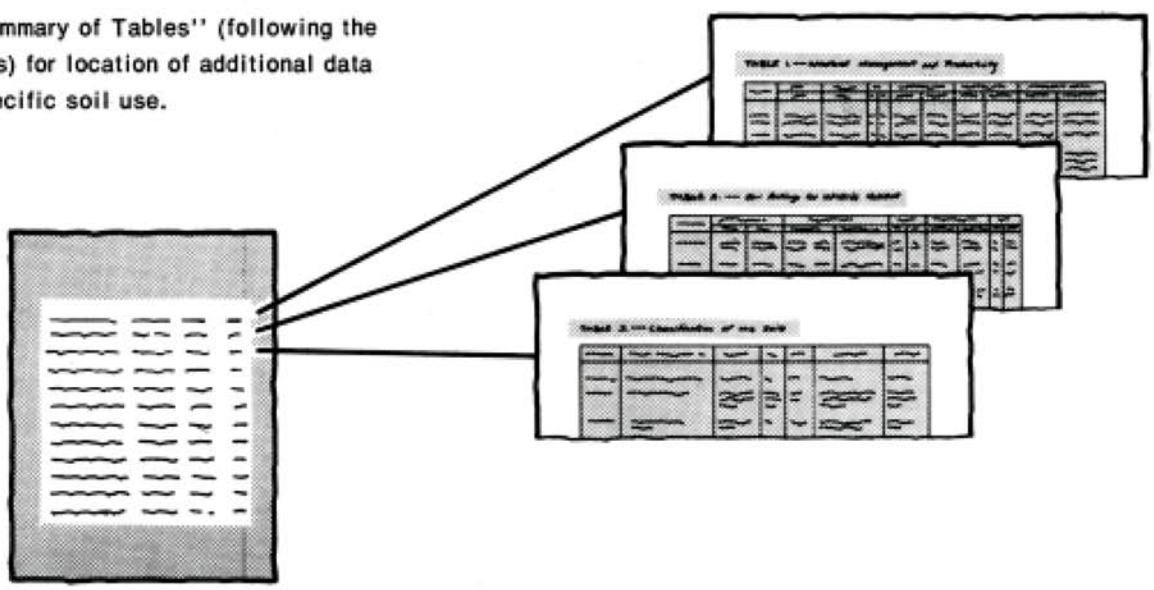


THIS SOIL SURVEY

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



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



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

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

This survey was made cooperatively by the Soil Conservation Service, the Oklahoma Agricultural Experiment Station, and the Oklahoma Conservation Commission. It is part of the technical assistance furnished to the Garvin Conservation District. Major fieldwork for this soil survey was completed in 1981. Soil names and descriptions were approved in 1982. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1982.

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

Cover: Alfalfa on bottom land along the Washita River. The soil is Keokuk silt loam, rarely flooded.

Contents

Soil Series

Issued April 1985

Index to Map Units

Summary of Tables

Foreword

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

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

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

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

Roland R. Willis

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State Conservationist
Soil Conservation Service

Soil Survey of Garvin County, Oklahoma

Soils surveyed by Larry E. Kichler, Vinson A. Bogard, Joseph D. White, Armer G. Fielder, and Hubert L. Mobley, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service, in cooperation with the Oklahoma Agricultural Experiment Station and the Oklahoma Conservation Commission

Garvin County is in the Washita River Valley in the south-central part of Oklahoma (fig. 1). It has an area of 520,960 acres, or 814 square miles. It is bordered on the north by McClain County, on the east by Pontotoc County, on the south by Murray and Carter Counties, and on the west by Stephens and Grady Counties.

INSERT ILLUSTRATION 6A.

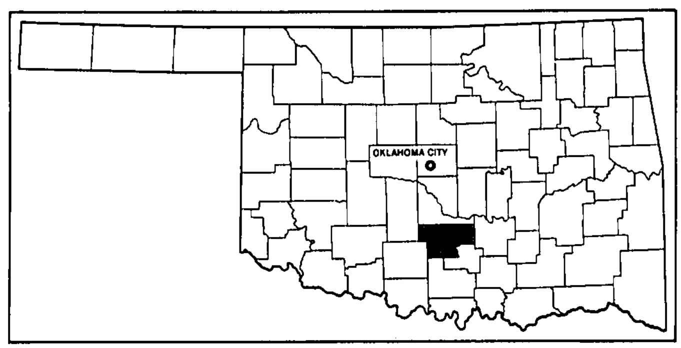

Figure 1.—Location of Garvin County in Oklahoma.

General Nature of the County

This section gives general information about the county. It describes the settlement and development, transportation and industry, relief and drainage, natural resources, and climate.

Settlement and Development

Garvin County was named for Samuel Garvin, a prominent Chickasaw Indian. The area was part of the Chickasaw Nation in Indian Territory established by treaty in 1855.

Goldseekers crossed Garvin County in 1849 on the way to California, and there were many military roads in the area long before statehood. Fort Arbuckle was established near the county's southern boundary in 1851 on the Indian Meridian Base Line. It was the initial point from which all surveys were made in alloting lands and determining property ownership in what became Oklahoma. Fort Arbuckle was abandoned in 1870, and little remains there today.

Pauls Valley, the county seat, was named after pioneer settler Smith Paul, who was the first white settler in the area. Paul owned much of the valley. He described this portion of the Indian Nation in 1847 as "a section where the bottom land was rich and the bluestem grass grew so high that a man on horseback was almost hidden in its foliage." The Washita Valley Historical Museum in Pauls Valley has archeological and anthropological exhibits of the area.

What was once the largest farm in cultivation in Indian Territory is at Erin Springs near Lindsay. The owner of this land was rancher Frank Murray. He owned 20,000 acres and had cornfields three miles wide and five miles long. The Murray residence, which was built in 1880, is a handsome, three-story structure that has been restored to its original elegance.

Garvin County is the center of an agricultural area that produces alfalfa, wheat, cotton, soybeans, pecans, peanuts, corn, grain sorghum, and cattle. Crops are grown mostly on the fertile Washita bottom land. There are also fruit orchards and nurseries in the county. About 60 percent of the county is rangeland and tame pasture.

The other 40 percent is used for cropland and urban development.

Transportation and Industry

Garvin County is served by a network of state and federal highways. U.S. Highways 177 and 77 and Interstate 35 along with state and provincial highways 76, 74, 133, and 59B cross the county in a north-south direction. State and provincial highways 19, 29, 7, and 145 cross the county in an east-west direction. The county is also served by two airports, two railroads, and numerous all-weather county roads.

Agriculture is an important part of the economy of Garvin County. Livestock production is the chief agricultural enterprise, and commercial production of alfalfa is another major source of income. Oil and gas production add a great deal to the economy of the county. There are two petroleum refineries, numerous oil well service companies, an apparel plant, a plastics manufacturer, and numerous other industries that help to stabilize the local economy.

Drainage and Relief

Garvin County is in the Central Rolling Red Prairies, Cross Timbers, and Grand Prairie major land resource areas. It is located in two river watersheds. About 95 percent of the county drains into the Washita River basin and the other 5 percent drains into the South Canadian River basin. The Washita River flows from the extreme northwest and passes just north and east of Pauls Valley and exits through the southern part of the county, dividing Garvin and Murray Counties. The South Canadian River is a few miles northeast of Garvin County, and a small area in the northeastern corner of the county drains into its basin.

Topography varies from the broad, nearly level land of the Washita River benches to the gently rolling terrain over most of the county. In the extreme west-central portion of the county, there are areas of steep slopes below escarpments of sandstone that are known as Table Hills. The elevation ranges from about 1,300 feet in the extreme west-central part of the county to about 785 feet in the southeast where the Washita River leaves the county.

Natural Resources

The most important natural resources in the county are the highly productive soils on the Washita River bottom lands, water available for irrigation, and large reserves of oil and gas.

Alfalfa and wheat are the principal crops in the county. Other important crops are peanuts, cotton, soybeans, and grain sorghum. Soybeans commonly follow wheat as a second crop. Alfalfa is the dominant crop along the Washita bottom lands with wheat, soybeans, and grain sorghum grown to a lesser extent. These crops are produced on such soils as Dale, Keokuk, and Asher soils. Peanuts, corn, and grain sorghum are produced in the Stratford area on Justin and Durant soils. Peaches and some apples are also produced in the Stratford area on such soils as Konawa and Bonham soils.

Water for irrigation is available from the Washita River and from shallow wells along the flood plains. A narrow area north of Stratford also furnishes sizeable amounts of water for irrigation. There are 144 watershed lakes scattered throughout the county, and some are suitable for irrigating small acreages.

Oil and natural gas production is important in most parts of the county. The Golden Trend oilfield is one of the largest fields in the county. Other oilfields are the Eola-Robberson field and the Pauls Valley southeast fields. The average oil or gas well depth is 5,486 feet.

Other resources include some sand in creek beds and gravel suitable for road surfacing that is available in the eastern part of the county. Deposits of copper ore are in the north and northeastern part of the county. These deposits of copper ore are not large enough to be worked, nor is it economical to do so at this time.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Pauls Valley in the period 1951 to 1977. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 45 degrees F, and the average daily minimum temperature is 32 degrees. The lowest temperature on record, which occurred January 10, 1977, is minus 10 degrees. In summer the average temperature is 82 degrees, and the average daily maximum temperature is 95 degrees. The highest recorded temperature, which occurred on August 6, 1956, is 112 degrees.

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

The total annual precipitation is 33 inches. Of this, 21 inches, or 63 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 9 inches. The heaviest 1-day rainfall during the period of record was 5.9 inches on October 8, 1970. Thunderstorms occur on about 50 days each year, and most occur in summer.

The average seasonal snowfall is 8 inches. The greatest snow depth at any one time during the period of record was 9 inches. On an average of 3 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 50 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 75 percent of the time possible in summer and 60 percent in winter. The prevailing wind is from the south-southwest. Average windspeed is highest, 15 miles per hour, in spring.

Tornados and severe thunderstorms occur occasionally. These storms are local and of short duration, and the pattern of damage is variable and spotty.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

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

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

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

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

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

Map Unit Composition

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

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

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

General Soil Map Units

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

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

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

The soils in the survey area vary widely in their potential for major land uses. Soil potential ratings are based on the practices commonly used in the survey area to overcome soil limitations. These ratings reflect the ease of overcoming the limitations. They also reflect the problems that will persist even if such practices are used.

Each map unit is rated for *cultivated crops, specialty crops, rangeland, tame pasture,* and *urban uses*. Cultivated crops are those grown extensively in the survey area. Specialty crops are the vegetables and fruits that generally require intensive management. Rangeland refers to areas of native grasses. Tame pasture refers to areas of introduced grasses. Urban uses include residential, commercial, and industrial developments.

Soil Descriptions

Deep, well drained and moderately well drained, loamy or clayey soils; on flood plains

The two map units in this group make up about 24 percent of Garvin County. The soils are used mainly for crops and tame pasture.

1. Keokuk-Yahola-Dale

Deep, nearly level, moderately permeable and moderately rapidly permeable, loamy soils that formed in loamy alluvium

This map unit is made up of nearly level soils on flood plains mainly along the Washita River. Slopes range from 0 to 1 percent.

The landforms of this unit exhibit little diversity. The vegetation is primarily cultivated crops with limited variation in pattern. Water elements are local drainageways. Manmade structures are uncommon because of the flood hazard. Visual diversity of this unit is low, and any changes in the landscape would be significant to this rating.

This unit covers about 11 percent of the county. It is about 24 percent Keokuk soils, 19 percent Yahola soils, 18 percent Dale soils, and 39 percent soils of minor extent.

The Keokuk soils are nearly level, well drained, and moderately permeable. They are on broad, smooth flood plains. Typically, they have a surface layer of dark brown and reddish brown silt loam and a subsoil of red silt loam. The underlying material is red very fine sandy loam.

The Yahola soils are nearly level, well drained, and moderately rapidly permeable. They are on broad, smooth flood plains. Typically, they have a surface layer of reddish brown fine sandy loam and the underlying material is reddish yellow fine sandy loam and loamy fine sand.

The Dale soils are nearly level, well drained, and moderately permeable. They are also on broad, smooth flood plains. Typically, they have a surface layer of dark brown and reddish brown silt loam and a subsoil of yellowish red silt loam. The underlying material is red silt loam.

The minor soils in this unit are the moderately well drained Asher and McLain soils on the lower slightly concave areas; the somewhat poorly drained Lela soils next to the foot slopes and in depressional areas; the well drained Amber soils on the alluvial breaks; and the Yahola and Gaddy soils next to the Washita River channel.

The soils of this unit are used mainly for crops, but a small acreage is used for tame pasture. The potential is high for crop and pasture production. The soils can be worked over a wide range of moisture conditions, and they respond well to intensive management. Surface drainage may be a problem in some areas during periods of high rainfall.

Because these soils are subject to flooding, the potential is low for building site developments. The flooding hazard can be reduced but not completely eliminated by upstream flood control.

2. Port-Garvin-Pulaski

Deep, nearly level, moderately permeable, very slowly permeable, and moderately rapidly permeable, loamy or clayey soils that formed in loamy or clayey alluvium

This map unit is made up of nearly level soils on narrow to broad flood plains mainly on creeks throughout Garvin County. Slopes range from 0 to 1 percent.

The topography of this unit is uniform, and there is limited diversity in the landforms. The vegetation patterns show little diversity because most of the unit is used for cultivated crops or tame pasture. Water elements are major drainageways with some diversity in shoreline. Manmade structures are uncommon in this unit because of the flood hazard. The visual diversity of this unit is low. Any changes in the landscape would be significant to this rating unless steps were taken to make the change compatible with the surrounding landscape.

This unit covers about 13 percent of the county. It is about 36 percent Port soils, 27 percent Garvin soils, 11 percent Pulaski soils, and 26 percent soils of minor extent.

The Port soils are nearly level, well drained, and moderately permeable. They are on narrow to broad flood plains. Typically, they have a surface layer of reddish brown silt loam and a subsoil of reddish brown silty clay loam. The underlying material is reddish brown stratified silt loam and silty clay loam.

The Garvin soils are nearly level, moderately well drained, and very slowly permeable. They are on narrow to broad flood plains. Typically, they have a surface layer of very dark gray silty clay loam and black silty clay and a subsoil of reddish brown clay loam. The underlying material is dark reddish gray clay.

The Pulaski soils are nearly level, well drained, and moderately rapidly permeable. They are on narrow to broad flood plains. Typically, they have a surface layer of reddish brown fine sandy loam and the underlying material is yellowish red and reddish yellow fine sandy loam stratified with clay loam, fine sandy loam, and loamy fine sand.

The minor soils in this unit are the well drained Yahola soils next to the major creek channels; the well drained Elandco soils along some of the smaller streams; the well drained Asa soils in concave positions; the somewhat poorly drained Gracemont soils; and the well drained Bergstrom soils on flood plains draining from the Arbuckle Mountains.

The soils in this unit are used mainly for crops or tame pasture. A small acreage is in rangeland and pecan groves. Broad, smooth areas that are occasionally flooded have high potential for crop production, rangeland, and tame pasture. Port and Pulaski soils can be worked over a wide range of moisture conditions, but the Garvin soils are limited by their more clayey surface texture. The soils respond well to intensive management. Surface drainage may be a problem, especially on the Garvin soils, during periods of high rainfall.

The soils in this unit have low potential for building sites. Flooding is the main limitation and is difficult to overcome. The Garvin soils are also limited by shrinking and swelling.

Deep to shallow, well drained and moderately well drained, loamy and clayey soils; on prairie uplands

The four map units in this group make up about 50 percent of Garvin County. The soils are used mainly for crops, tame pasture, and rangeland.

3. Clarita-Durant

Deep, nearly level to strongly sloping, very slowly permeable, clayey and loamy soils that formed in material weathered from shale or formed in clay

This map unit consists of nearly level to strongly sloping soils on rolling uplands primarily in the northeastern part of the county. Most areas of this unit are drained by small streams. Slopes range from 0 to 12 percent.

Slopes in this unit provide some diversity to the landforms. Diverse vegetation patterns result from land uses involving crops and tame pasture with small areas of rangeland and orchards. Water elements in this unit are small streams and occasional small farm ponds. The visual diversity of this unit is medium, and most changes in the landscape would be insignificant to this rating.

This unit covers about 13 percent of the county. It is about 62 percent Clarita soils, 24 percent Durant soils, and 14 percent soils of minor extent.

The Clarita soils are very gently sloping to strongly sloping, moderately well drained, and very slowly permeable. They are on broad, upland ridges and erosional side slopes. Typically, they have a surface layer of very dark gray clay and a subsoil of brown clay. The underlying material is reddish brown clay.

The Durant soils are nearly level to gently sloping, moderately well drained, and very slowly permeable. They are on broad, smooth upland flats. Typically, they have a surface layer of dark grayish brown loam. The upper part of the subsoil is dark grayish brown silty clay loam, the middle part is dark brown and yellowish brown mottled clay, and the lower part of the subsoil is brown mottled clay.

The minor soils in this unit are the moderately well drained Burleson soils on the broader ridge crests, the somewhat poorly drained Wilson soils in depressional areas, the well drained Tussy soils on the lower erosional side slopes, the moderately well drained Garvin soils and well drained Elandco soils on narrow drainageways, and the well drained Rayford soils on ridgetops and side slopes.

The Durant soils in this unit are used mainly for crops and tame pasture, but a small acreage is used for orchards and rangeland. The Clarita soils in this unit are used mainly for tame pasture and rangeland. A small acreage is used for crops. The potential is low for cultivated crops and medium for range and pasture production. It can be improved by controlling water erosion, maintaining soil structure and fertility, and rotating grazing. During periods of high rainfall, surface drainage may be a limitation in areas where the slope is less than 1 percent.

The soils in this unit have low potential for urban development. The very slow permeability and a high shrink-swell potential are the main limitations.

4. Grainola-Lucien

Moderately deep and shallow, very gently sloping to steep, slowly permeable and moderately rapidly permeable, loamy soils that formed in material weathered from shale, siltstone, or sandstone

This map unit consists of very gently sloping to moderately steep soils on rolling uplands mainly in the western part of the county. Slopes range from 2 to 30 percent.

The landforms of this unit are varied and diverse. The vegetation is in equally diverse patterns and consists mainly of range plants. Water elements in this unit are of limited extent and consist of short, narrow drainageways. The visual diversity of this unit is high as a result of the complex patterns of landforms and vegetation. Any changes in this unit could be significant to this rating because the soils are highly erodible.

This unit covers about 6 percent of the county. It is about 45 percent Grainola soils, 37 percent Lucien soils, and 18 percent soils of minor extent.

The Grainola soils are moderately deep, very gently sloping to moderately steep, well drained, and slowly permeable. They are on ridgetops and side slopes. Typically, they have a surface layer of reddish brown clay loam and a subsoil of red clay. The underlying material is red shale.

The Lucien soils are shallow, sloping to steep, well drained, and moderately rapidly permeable. They are on narrow ridge crests and hillsides. Typically, they have a surface layer of reddish brown loam and a subsoil of reddish brown very fine sandy loam. The underlying material is red, fine grained sandstone.

The minor soils in this unit are the well drained Nash, Renfrow, and Stephenville soils. These soils generally occur on the lower foot slopes, toe slopes, or ridgetop flats.

This unit is mainly rangeland. The steep slopes and clayey surface texture are limitations for tame pasture or cropland. These soils have medium potential for rangeland and low potential for crops and tame pasture.

The soils in this map unit have low potential for building sites because of the steep slopes, clayey texture of the Grainola soils, and shallow depth of the Lucien soils.

5. Renfrow-Zaneis

Deep, very gently sloping and gently sloping, very slowly permeable and moderately slowly permeable, loamy soils that formed in material weathered from shale

This map unit consists of very gently sloping to gently sloping soils mainly in the central part of the county. Most areas of this unit are drained by small streams. Slopes range from 1 to 5 percent.

The landforms in this unit are gently sloping and provide some diversity to the landscape. A mixture of tame pasture, rangeland, and some cropland provides diversity to the vegetation patterns. Water elements are drainageways, small streams, and farm ponds. The visual diversity of this unit is medium, and most changes would be insignificant to this rating.

This unit covers about 23 percent of the county. It is about 45 percent Renfrow soils, 30 percent Zaneis soils, and 25 percent soils of minor extent.

The Renfrow soils are very gently sloping to gently sloping, well drained, and very slowly permeable. They are on broad to narrow ridge crests and side slopes. Typically, they have a surface layer of dark brown silt loam. The upper part of the subsoil is reddish brown silty clay loam and clay, the middle part is yellowish red clay, and the lower part of the subsoil is red clay. The underlying material is red clayey shale. In some areas these soils are eroded or gullied.

The Zaneis soils are very gently sloping to gently sloping, well drained, and moderately slowly permeable. They are on narrow to broad ridgetops and smooth side slopes. Typically, they have a surface layer of reddish brown loam. The upper part of the subsoil is reddish brown clay loam, the middle part is red clay loam, and the lower part of the subsoil is light red clay loam. The underlying material is red sandy shale. In some areas these soils are eroded or gullied.

The minor soils in this unit are well drained. Bethany soils are on the broad flats; Grainola soils are on the lower foot slopes; Stephenville soils are next to the drainageways; Port and Pulaski soils are along narrow drainageways; and Loco, Lucien, and Nash soils are on the ridge crests and side slopes. Also, there are small areas of Oil-wasteland.

This unit is used mainly for tame pasture and rangeland. Some acreage is used for crops. The potential is medium for tame pasture, rangeland, and crops. These soils can be improved by controlling water erosion, maintaining soil structure and fertility, and rotating grazing.

The potential is low for building site development. A high shrink-swell potential and the very slow and moderately slow permeability are the main limitations for sanitary facilities and building site development.

6. Teller-Norge

Deep, nearly level to sloping, moderately permeable to moderately slowly permeable, loamy soils that formed in loamy alluvium

This unit consists of nearly level to sloping soils on broad, smooth flats and side slopes next to the Washita and along the larger stream tributaries in the county. Slopes range from 0 to 8 percent.

The upland areas of this unit show minimal variety in landforms; other areas have more varied slopes. Vegetation patterns vary over most of the unit. Water elements exhibit significant variety with diverse shorelines on the Washita River and large streams. A variety of structures have been built on this unit, which includes some Urban land. The visual diversity is medium, and most changes would be insignificant to this rating.

This unit covers about 8 percent of the county. It is about 80 percent Teller soils, 9 percent Norge soils, and 11 percent soils of minor extent.

The Teller soils are nearly level to sloping, well drained, and moderately permeable. They are on broad, smooth flats and side slopes near the Washita River. Typically, they have a surface layer of dark brown loam. The upper part of the subsoil is dark brown loam, the middle part of the subsoil is yellowish red clay loam, and the lower part of the subsoil is yellowish red fine sandy loam. The underlying material is reddish yellow fine sandy loam.

The Norge soils are nearly level to very gently sloping, well drained, and moderately slowly permeable. They are on broad, smooth convex flats of high terraces. Typically, they have a surface layer of brown silt loam and a subsoil of reddish brown silt loam, silty clay loam, or clay loam.

The minor soils in this unit are the well drained Vanoss and Justin soils. The Vanoss soils are mostly on the same landscape as Teller and Norge soils. Justin soils are in the northeastern part of the county. There is also some Urban land in this unit.

This unit is used mainly for crops, but some acreage is used for tame pasture and rangeland. The potential is medium for crops, rangeland, and tame pasture. The soils can be worked over a wide range of moisture conditions and respond well to intensive management. The very gently sloping to sloping soils are subject to water erosion if clean-tilled crops are grown. Returning crop residue to the soil and terracing can help prevent excessive erosion.

The soils in this unit have medium potential for most building sites. A moderate shrink-swell potential is the main limitation, and it can be easily overcome. The subsoil of the Norge soils has moderately slow permeability, which is a limitation for septic tank absorption fields.

Deep to moderately deep, moderately well drained and well drained, gravelly loamy, and sandy soils; on forested uplands

The three map units in this group make up about 26 percent of Garvin County. The soils are used mainly for rangeland or tame pasture.

7. Chigley

Deep, very gently sloping to strongly sloping, moderately slowly permeable, gravelly soils that formed in gravelly clay

This map unit consists of very gently sloping to strongly sloping soils on side slopes in the eastern part of the county. Most areas are drained by small streams. Slopes range from 1 to 12 percent.

The topography of this unit is varied; the slopes produce somewhat diverse landform patterns. Vegetation is mainly rangeland and tame pasture with occasional areas of cultivated crops. Vegetation patterns have high diversity. Water elements in this unit are small streams that have some diversity in shoreline and farm ponds. Manmade structures are scattered farmsteads. Visual diversity of this unit is medium. Most changes would be insignificant to this rating.

This unit covers about 5 percent of the county. It is about 90 percent Chigley soils and 10 percent soils of minor extent.

The Chigley soils are very gently sloping to strongly sloping, moderately well drained, and moderately slowly permeable. They are on broad to narrow ridgetops and side slopes. Typically, they have a surface layer of brown gravelly sandy loam and a subsurface layer of gravelly sandy loam. The upper part of the subsoil is reddish yellow gravelly clay, the middle part is red, mottled gravelly clay, and the lower part of the subsoil is reddish yellow mottled clay. The underlying material is light yellowish brown gravelly clay.

The minor soils in this unit are the well drained Tussy soils on erosional side slopes and narrow ridges; the moderately well drained Clarita soils on ridgetops; and the moderately well drained Garvin and well drained Elandco soils on narrow flood plains.

This unit is used mainly for rangeland and tame pasture. Some acreage is used for crops. The soils have medium potential for tame pasture or rangeland and low potential for crops. These soils can be improved by controlling water erosion, maintaining soil structre and fertility, and rotating grazing.

The soils in this map unit have medium potential for building sites. A high shrink-swell potential, the slope, and the moderately slow permeability are limitations for urban development.

8. Konawa-Konsil

Deep, nearly level to moderately steep, moderately permeable, loamy and sandy soils that formed in loamy alluvium or in material weathered from sandstone

This map unit consists of nearly level to moderately steep soils on ridgetops and side slopes in the northeastern corner of the county adjacent to the Washita River. Areas of this unit are dissected by small streams. Slopes range from 0 to 20 percent.

Topographic variations cause the landform patterns to be highly diverse. Tame pasture, rangeland, and cultivated cropland uses provide diversity to vegetation patterns. Small streams and drainageways provide varied water elements in the unit. Manmade structures in the unit consist of farmsteads and single-family residences. The visual diversity of this unit is high, and changes would be insignificant to this rating.

This unit covers about 4 percent of the county. It is about 53 percent Konawa soils, 42 percent Konsil soils, and 5 percent soils of minor extent.

The Konawa soils are very gently sloping to moderately steep, well drained, and moderately permeable. They are on smooth ridgetops and side slopes. Typically, they have a surface layer of pinkish gray loamy fine sand or fine sandy loam. The subsurface layer is pinkish gray loamy fine sand or fine sandy loam. The upper part of the subsoil is yellowish red sandy clay loam, and the lower part of the subsoil is reddish yellow fine sandy loam. The underlying material is reddish yellow fine sandy loam.

The Konsil soils are nearly level to sloping, well drained, and moderately permeable. They are on broad to narrow ridgetops and side slopes in the southern part of the county. Typically, they have a surface layer of yellowish brown loamy fine sand. The subsurface layer is light brown loamy fine sand. The upper part of the subsoil is red or reddish yellow sandy clay loam, and the lower part of the subsoil is reddish yellow fine sandy loam. The underlying material is reddish yellow, weakly cemented sandstone.

The minor soils in this unit are the moderately well drained Galey soils on broad, smooth ridgetops and the well drained Port and Pulaski soils on narrow flood plains.

This unit is used mainly for tame pasture and rangeland. Some acreage is used for orchards, truck crops, and field crops. The soils in this unit have medium potential for tame pasture, rangeland, and crops. These soils can be improved by controlling wind and water erosion, maintaining soil structure and fertility, and rotating grazing.

The potential is high for building site development. Seepage is the main limitation for sewage lagoons and trench type sanitary landfills.

9. Stephenville-Newalla

Moderately deep to deep, very gently sloping to moderately steep, moderately permeable and very slowly permeable, loamy soils that formed in material weathered from sandstone or clayey shale

This map unit consists of very gently sloping to moderately steep soils on ridgetops and side slopes primarily in the western and southern parts of the county. Most areas are drained by small streams. Slopes range from 1 to 20 percent.

The landforms of this unit exhibit uniform slopes with some variation in pattern. The vegetation is tame pasture, range grasses, and some areas of cultivated crops in a diverse pattern. Small streams and farm ponds are the water elements in this unit. Manmade structures such as farmsteads and single-family residences provide additional diversity. This unit has medium visual diversity. Any changes in this unit would be insignificant to this unit.

This unit covers about 17 percent of the county. It is about 67 percent Stephenville soils, 22 percent Newalla soils, and 11 percent soils of minor extent.

The Stephenville soils are very gently sloping to moderately steep, well drained, and moderately permeable. They are on broad to narrow ridgetops and erosional side slopes. Typically, they have a surface layer of brown fine sandy loam or stony fine sandy loam. The subsurface soil is brown fine sandy loam. The subsoil is red sandy clay loam. The underlying material is light red sandstone. A sizable acreage is eroded or gullied. Numerous gullies have exposed sandstone in some areas.

The Newalla soils are very gently sloping to sloping, moderately well drained, and very slowly permeable. They are on broad ridge crests and narrow erosional side slopes. Typically, they have a surface layer of brown and light reddish brown fine sandy loam. The upper part of the subsoil is reddish brown sandy clay loam, the middle part is reddish brown and red clay, and the lower part of the subsoil is light red sandy clay. The underlying material is reddish yellow, soft sandstone and clayey shale. Some areas of this unit are eroded and gullied.

The minor soils in this unit are the well drained Port and Pulaski soils along narrow flood plains, the well drained to somewhat excessively drained Darnell soils on ridgetops, and Oil-wasteland.

This map unit is used mainly for tame pasture and rangeland. Some acreage is used for crops. The soils have medium potential for tame pasture and rangeland and low potential for crops. These soils can be improved by controlling water erosion, maintaining soil structure and fertility, and rotating grazing.

The soils in this unit have low potential for building sites. The depth to rock and a high shrink-swell potential are the main limitations for sanitary facilities and building site development.

Visual Resources

David G. Thompson, landscape architect, Soil Conservation Service, helped prepare this section.

The appearance of Garvin County is an important natural resource, worthy of inventory, evaluation, and management. This visual resource is defined in terms of basic elements that are readily visible on the landscape. As with any natural resource, visual resources are a valuable asset and should be properly managed.

Each general soil map unit is a unique landscape that has a distinct appearance, or visual resource. The visual resources of the general soil map units were described during this survey. Descriptions were based on a comparison of the different landscapes within the county and the patterns created by the basic landscape elements: landforms, vegetation, water areas, and manmade structures. The overall visual diversity of each landscape was rated high, medium, or low.

A landscape that has high visual diversity has some or all of the following characteristics: variations in landforms, unique plant communities, varied vegetative patterns, rivers, streams, lakes, or ponds with diverse shorelines, and many or diverse manmade structures.

In areas of low visual diversity, one landscape element may be so dominant that it creates a continuous appearance with little or no contrast in pattern. Low-diversity landscapes may have some of the following characteristics: landforms with no variety; vegetative cover with no variation in type, height, or color; water bodies and shorelines with no variety; and few manmade structures.

The potential impact on the visual resources should be carefully analyzed for any proposed change in land use. A single practice can affect the visual resources of an area in more than one way. For example, a wooded area of a sloping soil that is cleared and planted to row crops could be severely eroded during the winter if it is not protected by plant cover. The visual resources would be affected not only by the bare, eroded areas but also by an increase in the amount of silt in the water and a loss of other vegetation as a result of increased runoff. On the other hand, grading and revegetating eroded areas could reverse these effects.

In some areas, land use practices have extensively changed the visual resources. Careful management and consideration of soil behavior, land use requirements, and the landscape elements can help to preserve or enhance the visual resources of Garvin County. Assistance in resource planning is available from the local office of the Soil Conservation Service.

Detailed Soil Map Units

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Zaneis loam, 1 to 3 percent slopes, is one of several phases in the Zaneis series.

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

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Yahola-Gaddy complex, frequently flooded, 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 similar interpretations can be made for use and management. The pattern and proportion of the soils in a mapped area are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Stephenville and Newalla soils, 2 to 8 percent slopes, gullied, is an undifferentiated group in this survey area.

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

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

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil Descriptions

1—Amber very fine sandy loam, 1 to 3 percent slopes, rarely flooded. This deep, well drained, very gently sloping soil is on flood plains that are rarely flooded. Slopes are usually convex. Individual areas are 10 to 150 acres.

Typically, the surface layer is reddish brown very fine sandy loam that extends to a depth of about 9 inches. The subsoil is red very fine sandy loam that extends to a depth of 42 inches. The underlying material is red very fine sandy loam that is stratified with thin layers of silt loam to a depth of more than 80 inches.

This soil has a high available water capacity. Permeability is moderate, and surface runoff is medium. This soil has good tilth and can be worked over a wide range of moisture conditions.

Included with this soil in mapping are small areas of more nearly level Keokuk soils. These included soils make up about 10 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Amber soil are used for crops. Some areas are used for tame pasture or range.

This soil has high potential for most cultivated crops. It is primarily used for grain sorghum, wheat, and alfalfa. A few areas are used for cotton. Control of water erosion and maintenance of soil fertility and desirable structure are the main concerns of soil management. Water erosion can be controlled by providing an adequate cover of close-growing crops or crop residue on the soil. Changing the tillage depth and tilling at a time when least compaction would occur will help maintain good soil structure and reduce the chances of a tillage pan forming. High soil fertility can be maintained by returning large amounts of crop residue to the soil and applying adequate kinds and amounts of fertilizer on a yearly basis.

Potential is high for native grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Proper stocking rates, rotation of grazing, timely deferment of grazing, and restricted use during wet periods can help to keep the soil in good condition.

This soil has medium potential for most urban uses. Most properties of this soil are favorable for building sites although the soil is subject to rare flooding for very brief periods.

This soil is in capability class IIe and in the Loamy Bottomland range site.

2—Asa silty clay loam, occasionally flooded. This deep, well drained, nearly level soil is on flood plains that are occasionally flooded. Slopes range from 0 to 1 percent and are usually smooth with some slightly concave areas. Individual areas are 25 to 100 acres.

Typically, the surface layer is brown silty clay loam that extends to a depth of 11 inches. The upper part of the subsoil is dark brown silty clay loam that extends to a depth of 16 inches. The lower part of the subsoil is reddish yellow silty clay loam that extends to a depth of 45 inches. The underlying material is dark brown silty clay loam stratified with thin layers of loam and loamy fine sand to a depth of 72 inches.

This soil has a high available water capacity. Permeability is moderate. Runoff is slow, and surface water stays in depressional areas for long periods. Tillage is limited by the silty clay loam texture and slow runoff.

Included with this soil in mapping are soils with buried horizons. Minor areas of Port and Garvin soils are also included. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

This Asa soil is used mainly for tame pasture or hay, but some areas are used for crops.

This soil has medium to high potential for crops. Wheat and grain sorghum are most commonly grown. Maintaining or improving soil fertility and controlling floods are the main concerns of management. Growing crops that are high in residue, returning the residue to the soil, and adding adequate amounts of fertilizer will maintain or increase soil fertility. Flooding can be reduced by watershed protection projects placed upstream for flood control. Straightening and deepening the stream channel on a community basis would help improve surface runoff where it is a problem.

Potential is high for native grasses, tame pasture, and hay. Bermudagrass is the main plant used for tame pasture on this soil. Proper stocking rates, rotation of grazing, timely deferment of grazing, and restricted use during wet periods can help to keep the grass and soil in good condition.

This soil has low potential for building sites. Avoid the use of this soil for residential and urban sites. Upstream flood control and channel improvement measures can lessen the flood hazard.

This soil is in capability subclass IIw and in the Loamy Bottomland range site.

3—Asher silty clay loam, rarely flooded. This deep, well drained, nearly level soil is on flood plains that are rarely flooded. Slopes are smooth and slightly convex ranging from 0 to 1 percent. Individual areas are 50 to 300 acres.

Typically, the surface layer is dark reddish brown silty clay loam that extends to a depth of 16 inches. The subsoil is reddish brown silty clay loam that extends to a depth of 38 inches. The underlying material is yellowish red, stratified silt loam to a depth of more than 80 inches.

This soil has a high available water capacity. Permeability is slow, and surface runoff is slow. This soil has fair tilth, except in some small depressional areas. There is a narrow range of moisture conditions when tillage of this soil is best.

Included with this soil in mapping are small areas of nearly level Dale soils. Also included in a few depressional areas are soils that have a clayey surface layer. These included soils make up about 10 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Asher soil are used for crops. Few areas are used for tame pasture.

This soil has high potential for most cultivated crops. It is primarily used for alfalfa and wheat. A few areas are used for cotton and grain sorghum (fig. 2). Maintenance of soil fertility and desirable soil structure are the main concerns of soil management. Land leveling is important on areas that are to be irrigated. Changing the tillage depth and tilling at a time when least compaction would occur will help maintain good soil structure and reduce the chances of a tillage pan forming. High soil fertility can be maintained by returning large amounts of crop residue to the soil and applying adequate kinds and amounts of fertilizer on a yearly basis.

Figure 2.—Grain sorghum on Asher silty clay loam, rarely flooded.

Potential is high for native grasses, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Proper stocking rates, rotation of grazing, timely deferment of grazing, and restricted use during wet periods can help to keep the grass and soil in good condition.

This soil has low potential for most urban uses. The hazard of flooding, surface wetness, and slow permeability are the main limitations. Most factors are favorable for sanitary facilities although this soil may be subject to flooding for very brief periods.

This soil is in capability class I and the Loamy Bottomland range site.

4—Asher-Urban land complex, rarely flooded. This complex consists of deep, well drained, nearly level Asher soils and areas of Urban land on flood plains that are rarely flooded. Urban land is used for buildings, streets, houses, and roads. Areas of these soils and Urban land are so intermingled that they could not be shown separately at the scale selected for mapping.

The Asher soils make up about 45 percent of the unit. Typically, the surface layer is dark reddish brown silty clay loam that extends to a depth of about 16 inches. The subsoil is reddish brown silty clay loam that extends to a depth of 38 inches. The underlying material is yellowish red, stratified silt loam to a depth of more than 80 inches.

Asher soils have a high available water capacity. Permeability is slow, and surface runoff is slow. These soils have fair tilth except in some small depressional areas. There is a narrow range of moisture conditions when tillage is best.

In about 30 percent of the acreage of this unit, the Asher soils have been modified by excavating, filling, and grading. In excavated and filled areas, the surface layer is a mixture of loamy and clayey material.

Urban land makes up about 20 percent of the unit. It is used for buildings, streets, houses, and roads. Urban land has very rapid surface runoff.

Included in mapping are small areas of Dale, Keokuk, and McLain soils. These included soils make up about 35 percent of the unit.

This complex is used mostly for urban development, picnic areas, playgrounds, houses, roads, and streets.

Flooding is the main concern in urban areas. The Asher soil is well suited to trees, shrubs, flowers, lawn grasses, and garden plants. Wetness and flooding are limitations for picnic areas, playgrounds, paths, and trails. Flooding is the main limitation for dwellings, commercial buildings, and camp areas.

Flooding and other unfavorable soil features limit the use of this complex for septic tank absorption fields, sewage lagoons, trench type sanitary landfills, roads, and streets.

No capability subclass or range site has been assigned to this complex.

5—Bergstrom silt loam, occasionally flooded. This deep, well drained, nearly level soil is on flood plains that are occasionally flooded. Slopes range from 0 to 1 percent. Individual areas are 5 to 100 acres.

Typically, the surface layer is dark grayish brown silt loam that extends to a depth of 22 inches. The subsoil is brown silty clay loam that extends to a depth of 71 inches. The underlying material is reddish brown clay loam to a depth of more than 80 inches.

This soil has a high available water capacity. Permeability is moderate, and surface runoff is slow. This soil has good tilth and a deep root zone that is easily penetrated.

Included with this soil in mapping are small areas of Asa, Elandco, and Port soils. Also included are minor areas of soils that are mottled in the subsoil. These included soils make up about 10 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Bergstrom soil are used for crops. A few areas are used for tame pasture or hay.

This soil has high potential for most cultivated crops. It is primarily used for alfalfa and wheat. Maintenance of soil fertility and desirable structure are the main concerns of soil management. Changing tillage depth and tilling at a time when least compaction would occur will help maintain good soil structure and reduce the chances of a tillage pan forming. High soil fertility can be maintained by returning large amounts of crop residue to the soil and applying adequate kinds and amounts of fertilizer on a yearly basis.

Potential is high for native grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods can help to keep the grass and soil in good condition.

The potential for most urban uses is low. The risk of damaging floods is the main limitation. Upstream flood-control structures, however, have lessened this risk, but flooding is still a possibility.

This soil is in capability subclass IIw and in the Loamy Bottomland range site.

6—Bethany silt loam, 0 to 1 percent slopes. This deep, well drained, nearly level soil is on broad, smooth to convex uplands. Individual areas are 5 to 160 acres.

Typically, the surface layer is dark grayish brown silt loam that extends to a depth of about 7 inches. The upper part of the subsoil is dark grayish brown silty clay loam that extends to a depth of 16 inches. The middle part of the subsoil is brown and light yellowish brown clay that extends to a depth of 46 inches. The lower part of the subsoil is reddish yellow clay with brownish mottles to a depth of 78 inches or more.

This soil has a high available water capacity. Permeability is slow, and surface is slow. The root zone is deep, but the clayey subsoil restricts root growth.

Included with this soil in mapping are small areas of soils that have a high sodium content. Also included are areas of Renfrow and Zaneis soils. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Bethany soil are used for crops, tame pasture,. or hay. Some areas are used for range.

This soil has high potential for crops. It is used primarily for wheat and grain sorghum. Important management practices on this soil are those that maintain a desirable soil structure and high level of fertility. Changing a tillage depth and tilling at a time when least compaction would occur will help maintain good soil structure and reduce the chances of a tillage pan forming. Additional fertilizer should be applied where crop residue is returned to the soil or left on the surface.

Potential is high for native grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods can help to keep the pasture and soil in good condition.

This soil has medium potential for most urban uses. It has a high shrink-swell potential that is the main limitation, but this can be overcome by good design and careful installation during construction. The slowly permeable subsoil is a limitation for septic tank absorption fields, but this can be overcome by increasing the size of the absorption area or modifying the field itself.

This soil is in capability class I and in the Loamy Prairie range site.

7—Bethany silt loam, 1 to 3 percent slopes. This deep, well drained, very gently sloping soil is on broad, smooth to convex ridges and side slopes of uplands. Individual areas are 5 to 120 acres.

Typically, the surface layer is dark grayish brown silt loam that extends to a depth of about 10 inches. The upper part of the subsoil is dark grayish brown silty clay loam that extends to a depth of 20 inches. The middle part of the subsoil is brown and pale brown clay that extends to a depth of 63 inches. The lower part of the subsoil is reddish yellow silty clay loam with very pale brown mottles to a depth of 81 inches or more.

This soil has a high available water capacity. Permeability is slow, and surface runoff is medium. The root zone is deep, but the clayey subsoil restricts root growth.

Included with this soil in mapping are small areas of a soil that has a high sodium content. Also included are areas of Renfrow and Zaneis soils. These included soils make up about 20 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Bethany soil are used for tame pasture, hay, or range. Some areas are used for crops.

This soil has high potential for crops. It is used primarily for wheat and grain sorghum. Important management practices on this soil are those that maintain a desirable soil structure and high level of fertility. Changing tillage depth and tilling at a time when least compaction would occur will help maintain good soil structure and reduce the chances of a tillage pan forming. Terraces can help control erosion. Additional fertilizer should be applied where crop residue is returned to the soil or left on the surface.

Potential is high for native grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing when the soil is too wet will cause excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil has medium potential for most urban uses. It has a high shrink-swell potential that is the main limitation, but this can be overcome by good design and careful installation during construction. The slowly permeable clayey subsoil is a limitation for septic tank absorption fields, but this can be overcome by increasing the size of the absorption area or modifying the field itself.

This soil is in capability subclass IIe and in the Loamy Prairie range site.

8—Burleson clay, 1 to 3 percent slopes. This deep, moderately well drained, very gently sloping soil is on broad, smooth to slightly convex ridges and upper side slopes of uplands. Individual areas are 5 to 100 acres.

Typically, the surface layer is very dark gray clay that extends to a depth of 20 inches. The next layer is dark gray clay that extends to a depth of 35 inches. The upper part of the subsoil is dark gray, mottled clay that extends to a depth of 52 inches. The lower part of the subsoil is coarsely mottled, light olive gray and pale olive clay to a depth of 66 inches.

This soil has a high available water capacity. Permeability is very slow, and surface runoff is medium. The root zone is deep, but the clayey subsoil restricts root growth. Surface crusting is a problem.

Included in mapping are areas of soils that are similar to the Burleson soil except that they are calcareous. A few areas of Durant and Clarita soils are also included. These included soils make up about 20 percent of the unit, but individual areas are generally less than 5 acres.

Many areas of this Burleson soil are used for crops. Some areas are used for tame pasture or hay.

This soil has medium potential for most cultivated crops. Wheat and grain sorghum are the main crops. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns of soil management. Water erosion can be controlled and soil tilth improved by keeping an adequate cover of crop residue on the soil surface. Where this cover is not adequate to control water erosion, terraces are needed. This clayey soil is difficult to till and is sticky when wet. Additional fertilizer should be applied where crop residue is returned to the soil or left on the surface.

Potential is medium for range, tame pasture, and hay. Bermudagrass, weeping lovegrass, King Ranch bluestem, and plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing the grass when the soil is too wet will cause surface crusting and excessive runoff. Proper stocking rates, rotation of grazing, timely deferment of grazing, and restricted use during wet periods can help to keep the grass and soil in good condition.

This soil has low potential for most urban uses. A high shrink-swell potential is the main limitation, but it can be overcome by good design and careful installation during construction. The very slowly permeable clayey subsoil is a limitation for septic tank absorption fields, but this can be overcome by increasing the size of the absorption area or modifying the field itself.

This soil is in capability subclass IIe and in the Blackclay Prairie range site.

9—Chigley gravelly sandy loam, 1 to 5 percent slopes. This deep, moderately well drained, very gently sloping to gently sloping soil is on smooth to convex ridges and side slopes of uplands. Individual areas are 5 to 200 acres.

Typically, the surface layer is brown gravelly sandy loam that extends to a depth of about 6 inches. The upper part of the subsoil is reddish yellow gravelly clay that extends to a depth of 18 inches. The middle part of the subsoil is red gravelly clay that extends to a depth of 42 inches. The lower part of the subsoil is reddish yellow clay that extends to a depth of 54 inches. The underlying material is light yellowish brown gravelly clay to a depth of 64 inches.

This soil has a high available water capacity, but it is droughty. Permeability is moderately slow, and surface runoff is medium to rapid. The water table is perched between depths of 3 and 4 feet in the winter and spring. The root zone is deep, but the clayey subsoil restricts root growth.

Included with this soil in mapping are small areas of Clarita soils. Also included are few areas of soils that are similar to the Chigley soil except that they are less than 40 inches deep over hard conglomerate bedrock. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Most areas are used for tame pasture or range. Some areas are used for crops.

This soil has low potential for crops. Its potential is limited by the thin gravelly surface layer over the clayey subsoil. Wheat and summer hay crops are grown. Under good management medium yields can be obtained. Tilth can be improved by returning crop residue to the soil. Erosion is a hazard if row crops are grown. Minimum tillage, terraces, using cover and soil-improving crops, and including grasses and legumes in the cropping system are practices that can help reduce runoff and control erosion.

The potential is medium for native grass, tame pasture, and hay. Range, tame pasture, or hay are effective for controlling erosion. Overgrazing or grazing when the soil is too wet will cause excessive runoff. Proper stocking rates, rotation of grazing, timely deferment of grazing, and restricted use during wet periods can help to keep the grass and soil in good condition.

This soil has medium potential for most urban uses. A moderate shrink-swell potential and the moderately slow permeability are limitations that can be overcome, in most instances, by careful design. Septic tank absorption fields are limited by the moderately slow permeability, but may be altered to provide a larger absorption area. Sewage lagoons can be substituted.

This soil is in capability subclass IVe and in the Sandy Savannah range site.

10—Chigley gravelly sandy loam, 5 to 12 percent slopes. This deep, moderately well drained, sloping to strongly sloping soil is on long and relatively narrow, smooth side slopes of uplands. Individual areas are 10 to 200 acres.

Typically, the surface layer is brown gravelly sandy loam that extends to a depth of about 4 inches. The subsurface layer is very pale brown gravelly sandy loam that extends to a depth of about 7 inches. The upper part of the subsoil, which extends to a depth of 16 inches, is brown clay that is 5 percent gravel. The lower part of the subsoil, which extends to a depth of 46 inches, is reddish brown clay that is 5 percent gravel. The underlying material is weak red clay.

This soil has a high available water capacity, but it is droughty. Permeability is moderately slow, and surface runoff is rapid. The water table is perched between depths of 3 and 4 feet in the winter and spring. The root zone is deep, but the clayey subsoil restricts root growth.

Included with this soil in mapping are small areas of Clarita soils. Also included are areas of soils that are similar to the Chigley soil, except that they are less than 40 inches deep over hard conglomerate bedrock. These included soils make up about 20 percent of the unit, but individual areas are generally less than 5 acres.

Some areas of this Chigley soil are used for tame pasture, but most areas are used for range.

This soil has low potential for crops. Its potential is limited by the steep slopes, thin gravelly surface layer, and clayey subsoil. The hazard of erosion is severe if this soil is cultivated.

The potential is medium for native grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Pasture and hay are effective for controlling erosion. Proper stocking rates, rotation of grazing, timely deferment of grazing, and restricted use during periods of drought can help to keep the grass and soil in good condition.

This soil has medium potential for most urban uses because of the slope. A moderate shrink-swell potential and the moderately slow permeability are limitations that can be overcome, in most instances, by careful design. Septic tank absorption fields are limited by the moderately slow permeability, but this can be overcome by enlarging the absorption area or substituting sewage lagoons.

This soil is in capability subclass VIe and in the Sandy Savannah range site.

11—Chigley and Clarita soils, 2 to 8 percent slopes, gullied. This map unit consists of deep, moderately well drained, very gently sloping to sloping Chigley and Clarita soils that are on side slopes of uplands. The Chigley soils are mainly on the upper part of side slopes; the Clarita soils are on the lower side slopes. Individual areas are 15 to 200 acres.

These soils have been cultivated in the past, and very severe water erosion has removed much of the topsoil and formed many gullies. Gullies are 10 to 25 feet in width, 1 to 6 feet in depth, and 200 to 400 feet apart. A gravelly conglomerate is exposed in many of the gullies adjacent to the Chigley soils. The pattern and extent of Chigley and Clarita soils are not uniform for each mapped area. Some areas consist mostly of Chigley soils, but most areas contain both Chigley and Clarita soils. Gullies average about 8 percent of the area.

The Chigley soils make up about 45 percent of the map unit. Typically, the surface layer is light brown gravelly loam that extends to a depth of about 6 inches. The upper part of the subsoil is reddish yellow gravelly clay that extends to a depth of about 20 inches. The lower part, which extends to a depth of 57 inches, is yellowish red clay that is 10 percent gravel. The underlying material is coarsely mottled, red and pale brown gravelly clay.

Chigley soils have a high available water capacity. Permeability is moderately slow, and surface runoff is medium to rapid. The water table is perched between depths of 3 and 4 feet in the winter and spring. The root zone is deep, but the gravelly surface and clayey subsoil limit root growth.

The Clarita soils make up about 40 percent of the map unit. Typically, the surface layer is very dark grayish brown clay that extends to a depth of about 6 inches. The upper part of the subsoil is dark brown clay that extends to a depth of 20 inches. The lower part of the subsoil is brown clay that extends to a depth of 50 inches. The underlying material is red and gray shaly clay.

Clarita soils have a high available water capacity. Permeability is very slow, and surface runoff is medium to rapid. The root zone is deep, but the clayey subsoil restricts root growth.

Included with these soils in mapping are small areas of Durant and Grainola soils. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Nearly all of this unit is used for range. It is no longer suitable for crops because of erosion.

This unit has low potential for tame pasture and range. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. The main concern in management is protecting the soil from accelerated erosion and improving soil fertility and structure. Planting and fertilizing tame pasture and legumes for maximum residues helps to reduce soil erosion. Runoff from higher areas should be diverted and banks of gullies shaped before establishing a permanent cover in most areas. Gullies should be shaped and sodded or planted to grass to minimize soil loss and siltation.

These soils have low potential for most urban uses. They are poorly suited to septic tank absorption fields. Foundations should be strengthened for building sites, and lagoons can be used for septic tank absorption fields.

These Chigley and Clarita soils are in capability subclass VIe. The Chigley soil is in the Eroded Sandy Savannah range site. The Clarita soil is in the Eroded Prairie range site.

12—Clarita clay, 2 to 5 percent slopes. This deep, moderately well drained, very gently sloping soil is on narrow to broad, smooth side slopes and ridgetops of uplands. Individual areas are 10 to 100 acres.

Typically, the surface layer is very dark gray clay that extends to a depth of about 25 inches. The subsoil is brown clay that extends to a depth of 45 inches. The underlying material is reddish brown clay to a depth of 80 inches.

This soil has a high available water capacity. Permeability is very slow, and surface runoff is medium. Tilth is fair. Optimum tillage is limited to a narrow range of moisture conditions. This soil cracks severely during prolonged dry periods.

Included with this soil in mapping are small areas of Burleson and Durant soils. Also included are a few areas of similar soils that have a dark brown surface. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this soil are used for crops, tame pasture, or hay. Some areas are used for range.

This soil has medium potential for crops. Wheat and grain sorghum are the main crops. Erosion is a hazard if cultivated crops are grown. This clayey soil is difficult to till and is sticky when wet. Minimum tillage, cover crops, high residue use, growing grasses and legumes in the cropping system, and installing a terrace system are practices that can help reduce runoff and control erosion.

The potential is medium for range grasses, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing when the soil is too wet will cause excessive runoff. Proper stocking rates, rotation of grazing, timely deferment of grazing, and restricted use during wet periods can help to keep the grass and soil in good condition.

This soil has low potential for most urban uses. It has a high shrink-swell potential, and permeability is very slow. Building developments on this soil require special engineering designs to overcome these limitations.

This soil is in capability subclass IVe and in the Blackclay Prairie range site.

13—Clarita clay, 3 to 5 percent slopes, eroded. This deep, moderately well drained, very gently sloping to gently sloping soil is on smooth ridgetops and side slopes of uplands. Individual areas are 10 to 100 acres of irregular shape.

Part of the original surface layer has been removed by erosion on about 65 percent of the area. In about 10 percent of the area, the surface layer and upper part of the subsoil have been mixed by tillage. Rills and some shallow gullies occur throughout the area.

Typically, the surface layer is very dark grayish brown clay that extends to a depth of 8 inches. The upper part of the subsoil is reddish brown, calcareous clay that extends to a depth of 24 inches. The lower part of the subsoil is yellowish red clay that extends to a depth of 40 inches. The underlying material is reddish brown, calcareous clay to a depth of 60 inches.

This soil has a high available water capacity. Permeability is very slow, and surface runoff is medium to high. There is a limited range of moisture conditions when this soil can be properly tilled. It cracks severely during prolonged dry periods.

Included with this soil in mapping are small areas of Burleson, Tussy, and Chigley soils. These included soils make up about 10 to 15 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this soil are used for range. Some areas are used for crops, and a small acreage is used for tame pasture.

This soil has low potential for crops. Where farmed, it is used primarily for wheat and grain sorghum. Erosion is a hazard if cultivated crops are grown. Minimum tillage, use of fertilizer, high residue use, growing grasses and legumes in the cropping system, and installing a terrace system are practices that can help reduce runoff and control water erosion.

The potential is medium for native grasses, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture grasses may be difficult to establish because of the low fertility and clayey surface texture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing when the soil is too wet will cause excessive runoff. Proper stocking rates, rotation of grazing, timely deferment of grazing, and restricted use during wet periods help to keep the grass and soil in good condition.

This soil has low potential for most urban uses. It has a high shrink-swell potential and very slow permeability. Building developments on this soil require special engineering designs to overcome these limitations.

This soil is in capability subclass IVe and in the Blackclay Prairie range site.

14—Clarita clay, 5 to 12 percent slopes, eroded. This deep, moderately well drained, sloping to strongly sloping soil is on narrow to broad side slopes of uplands. Individual areas are 10 to 100 acres of irregular shape.

Part of the original surface layer has been removed by erosion on about 55 percent of the area. Rills and some shallow gullies occur throughout the area.

Typically, the surface layer is very dark grayish brown clay that extends to a depth of 4 inches. The upper part of the subsoil is dark brown clay that extends to a depth of 10 inches. The middle part is brown clay that extends to a depth of 24 inches. The lower part of the subsoil is reddish brown clay that extends to a depth of 40 inches. The underlying material is red and gray, calcareous clay to a depth of 60 inches.

This soil has a high available water capacity. Permeability is very slow, and surface runoff high. This soil cracks severely during prolonged dry periods.

Included with this soil in mapping are small areas of Chigley and Tussy soils and soils that have redder surface layers. Also included are some areas of soils that have a solum thickness of less than 35 inches. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this soil are used for range. A small acreage is used for tame pasture and hay and is generally not suited for crops.

This soil has medium potential for growing native grasses and tame pasture. Tame pasture grasses may be difficult to establish because of the low fertility and the clayey surface texture. The main concerns of management are protecting the soil from erosion, improving water intake, and maintaining soil structure and fertility. The quality of native grasses can usually be improved by proper grazing, controlling weeds, and protecting from fire. Fertilizing tame pasture plants increases the amount of forage, improves the quality of grass, and protects the soil from eroding.

This soil has low potential for most urban uses. It has unstable slopes and a high shrink-swell potential. Most building uses of this soil need special engineering measures to counteract these soil features.

This soil is in capability subclass VIe and in the Blackclay Prairie range site.

15—Dale silt loam, rarely flooded. This deep, well drained, nearly level soil is on broad, smooth to slightly convex flood plains that are subject to rare flooding. Slopes are 0 to 1 percent. Individual areas are 25 to 350 acres.

Typically, the surface layer is dark brown silt loam that extends to a depth of about 9 inches. The next layer is reddish brown silt loam that extends to a depth of 22 inches. The subsoil is yellowish red silt loam that extends to a depth of 36 inches. The underlying material is red silt loam to a depth of more than 72 inches.

This soil has a high available water capacity. Permeability is moderate, and surface runoff is slow. This soil has good tilth and can be worked over a wide range of moisture conditions.

Included in mapping are small areas of Keokuk soils and soils similar to the Dale soil except that they have a dark surface layer less than 20 inches thick. These included soils make up about 20 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this soil are used for crops. A few areas are used for tame pasture and hay.

This soil has high potential for crops. It is primarily used for alfalfa and wheat. A few areas are used for corn, cotton, and soybeans. Maintenance of soil fertility and desirable structure are the main concerns of soil management. Changing tillage depth and tilling at a time when least compaction would occur will help maintain good soil structure and reduce the chances of a tillage pan forming. High soil fertility can be maintained by returning large amounts of crop residue to the soil and applying adequate kinds and amounts of fertilizer on a yearly basis.

The potential is high for tame pasture and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Proper stocking rates, rotation of grazing, timely deferment of grazing, and restricted use during wet periods can help to keep the grass and soil in good condition.

This soil has low potential for most urban uses because of the flooding hazard. Most of this soil's properties are favorable for building sites although this soil is subject to rare flooding for very brief periods.

This soil is in capability class I and in the Loamy Bottomland range site.

16—Dale-Urban land complex, rarely flooded. This complex consists of deep, well drained, nearly level Dale soils and areas of Urban land on flood plains that are rarely flooded. Urban land is used for buildings, streets, houses, and roads. Areas of these soils and Urban land are so intermingled that they could not be separated at the scale selected for mapping.

The Dale soils make up 45 percent of each mapped area. Typically, the surface layer is dark brown silt loam that extends to a depth of about 9 inches. The next layer is reddish brown silt loam that extends to a depth of 22 inches. The subsoil is yellowish red silt loam that extends to a depth of 36 inches. The underlying material is red silt loam to a depth of more than 72 inches.

Dale soils have a high available water capacity. Permeability is moderate, and surface runoff is slow. This soil has good tilth and can be worked over a wide range of moisture conditions.

In about 30 percent of the acreage of this unit, the Dale soils have been modified by excavating, filling, and grading. In excavated and filled areas, the surface layer is a mixture of loamy and sandy material.

Urban land makes up about 20 percent of the unit. It is used for buildings, streets, houses, and roads. Urban land has very rapid surface runoff.

Included in mapping are small areas of Asher, Keokuk, and McLain soils. These included soils make up about 35 percent of the unit.

This complex is used mostly for urban development, picnic areas, playgrounds, houses, roads, and streets.

The main concern of using this complex in urban areas is flooding. The Dale soil is well suited to trees, shrubs, flowers, lawn grasses, and garden plants. It has no significant limitations for picnic areas, playgrounds, paths, and trails. Flooding is the main limitation for camp areas, septic tank absorption fields, sewage lagoons, trench type sanitary landfills, dwellings, commercial buildings, roads, and streets.

No capability subclass or range site has been assigned to this complex.

17—Durant loam, 0 to 1 percent slopes. This deep, moderately well drained, nearly level soil is on broad, smooth to convex uplands. Individual areas are 30 to 200 acres.

Typically, the surface layer is dark grayish brown loam that extends to a depth of about 12 inches. The upper part of the subsoil is dark brown silty clay loam that extends to a depth of 18 inches. The middle part of the subsoil, which extends to a depth of 56 inches, is grayish brown clay with yellowish brown mottles. The lower part of the subsoil is grayish brown clay with distinct strong brown mottles to a depth of 70 inches or more.

This soil has a high available water capacity. Permeability is very slow, and surface runoff is slow. The root zone is deep, but the clayey subsoil restricts root growth.

Included with this soil in mapping are intermingled areas of Justin and Wilson soils that occur in concave areas. These included soils make up about 10 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Durant soil are used for crops (fig. 3). A few areas are used for tame pasture and hay. A small acreage is used for range.

This soil has medium potential for crops. Irrigation wells are available for some of the acreage. This soil is used primarily for wheat, grain sorghum, corn, and peanuts (fig. 4). Maintaining desirable soil structure and fertility are the main concerns of soil management. Returning crop residue to the soil and annually applying fertilizer will help maintain soil structure and fertility on cropland. Additional fertilizer should be applied where crop residue is returned to the soil or left on the surface.

The potential is high for range grasses, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Proper stocking rates, rotation of grazing, timely deferment of grazing, and restricted use during wet periods help to keep the grass and soil in good condition.

The soil has low potential for most urban uses. A high shrink-swell potential is the main limitation, but this can be overcome by good design and careful installation procedures. The clayey subsoil has very slow permeability, which is a severe limitation for septic tank absorption fields. This can be overcome by increasing the size of the absorption area or modifying the field.

This soil is in capability class I and in the Loamy Prairie range site.

18—Durant loam, 1 to 3 percent slopes. This deep, moderately well drained, very gently sloping soil is on broad, smooth to convex ridges and side slopes of uplands. Individual areas are 5 to 160 acres.

Typically, the surface layer is dark grayish brown loam that extends to a depth of about 10 inches. The upper part of the subsoil is dark grayish brown silty clay loam that extends to a depth of 14 inches. The middle part is dark brown and yellowish brown clay with reddish brown and brownish yellow mottles that extends to a depth of 48 inches. The lower part of the subsoil is brown clay with reddish brown mottles to a depth of 60 inches.

This soil has a high available water capacity. Permeability is very slow, and surface runoff is medium. The root zone is deep, but the clayey subsoil restricts root growth.

Included with this soil in mapping are small areas of soils that have a subsoil high in sodium. Also included are small areas of Clarita, Justin, and Wilson soils. The Clarita and Justin soils are on side slopes, and the Wilson soils are in concave areas. These included soils make up about 10 percent of the unit, but individual areas are generally less than 5 acres.

Figure 3.—Peanuts on Durant loam, 0 to 1 percent slopes. Corn is in upper right.

Figure 4.—Peanut harvest on Durant loam, 0 to 1 percent slopes.

Most areas of this Durant soil are used for crops. Some areas are used for tame pasture and hay. A few areas are used for range.

This soil has medium potential for most cultivated crops. It is used primarily for wheat, corn, peanuts, and grain sorghum. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns of soil management. Water erosion can be controlled by keeping an adequate cover of crop residue on the soil surface. Where this cover is not adequate to control water erosion, terraces are needed. Additional fertilizer should be applied where crop residue is returned to the soil or left on the surface.

Potential for tame pasture, range, and hay is medium. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing when the soil is too wet will cause excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods can help to keep the pasture and soil in good condition.

This soil has low potential for most building sites. A severe shrink-swell potential is the main limitation, but this can be overcome by good design and careful installation during construction. The clayey subsoil is very slowly permeable, which is a severe limitation for septic tank absorption fields. This can be overcome by increasing the size of the absorption area or by modifying the field itself.

This soil is in capability subclass IIe and in the Loamy Prairie range site.

19—Durant loam, 2 to 5 percent slopes, eroded. This deep, moderately well drained, very gently sloping to gently sloping soil is on smooth ridge crests and side slopes of uplands. Individual areas are 30 to 200 acres.

Part of the original surface layer has been removed by erosion in about 60 percent of the area. In about 20 percent of the area, the surface layer and upper part of the subsoil have been mixed by tillage. Rills and some shallow gullies occur throughout the area.

Typically, the surface layer is grayish brown loam that extends to a depth of 6 inches. The upper part of the subsoil is grayish brown clay with yellowish red mottles that extends to a depth of 10 inches. The middle part of the subsoil is light brownish gray clay with yellowish brown mottles that extends to a depth of 45 inches. The lower part of the subsoil is light gray clay with brownish yellow mottles to a depth of 60 inches.

This soil has a high available water capacity. Permeability is very slow, and surface runoff is rapid. The root zone is deep, but the clayey subsoil restricts root growth.

Included with this soil in mapping are small intermingled areas of Justin and Clarita soils. Also included are small areas of soils that have a subsoil high in sodium and a few areas of soils that have a reddish subsoil. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Durant soil are used for tame pasture, hay or range. Some areas of this soil are used for crops.

This soil has low potential for crops. Its potential is limited by low fertility and the thin surface layer over the clayey subsoil. Wheat and grain sorghum are the main crops. Under good management, medium yields can be obtained. Tilth can be improved by returning crop residue to the soil. Erosion is a hazard if this soil is cultivated. Minimum tillage, terraces, using cover and soil-improving crops, and including grasses and legumes in the cropping system are practices that can help reduce runoff and control erosion.

The potential is medium for native grasses, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing when the soil is too wet will cause excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods can help to keep the pasture and soil in good condition.

This soil has low potential for most building sites. A high shrink-swell potential and the very slow permeability are limitations for most uses. For most uses, these limitations can be overcome by careful design. Septic tank absorption fields are limited by the very slow permeability, but sewage lagoons can be substituted.

This soil is in capability subclass IVe and in the Loamy Prairie range site.

20—Durant clay loam, 2 to 5 percent slopes, gullied. This deep, moderately well drained, very gently sloping to gently sloping gullied soil is on side slopes of uplands. Gullies caused by water erosion are 15 to 70 feet in width and 1 to 3 feet in depth and are 200 to 500 feet apart. Most of the original surface layer has been removed by erosion in about 50 percent of the area. In some areas the surface layer has been mixed with the subsoil by tillage. Gullies make up about 5 to 10 percent of the area. Individual areas are 20 to 200 acres.

Typically, the surface layer has a dark grayish brown clay loam that extends to a depth of 3 inches. The upper part of the subsoil is grayish brown mottled clay that extends to a depth of 32 inches. The lower part of the subsoil is brown mottled clay that extends to a depth of 72 inches.

This soil has a high available water capacity. Permeability is very slow and surface runoff is rapid. The root zone is deep but the clayey subsoil restricts root growth.

Included with this soil in mapping are small intermingled areas of Justin and Clarita soils. Also, included are small areas of soils that have a subsoil high in sodium. The included soils make up about 15 percent of this mapping unit, but individual areas are generally less than 5 acres.

Nearly all of this Durant soil is used for tame pasture or range. It is generally no longer suitable for crops.

This soil has low potential for most building sites. A high shrink-swell potential and the very slow permeability are limitations for most uses. For most uses, these limitations can be overcome by careful design. Septic tank absorption fields are limited by the very slow permeability, but sewage lagoons can be substituted.

This soil is in capability subclass IVe and in the Loamy Prairie range site.

21—Elandco silty clay loam, occasionally flooded. This deep, well drained, nearly level soil is on flood plains that are occasionally flooded. Slopes are smooth to concave and range from 0 to 1 percent. Individual areas are 5 to 100 acres.

Typically, the surface layer is dark grayish brown silty clay loam that extends to a depth of 15 inches. The next layer is dark brown silty clay loam that extends to a depth of 48 inches. The underlying material is dark grayish brown silty clay loam to a depth of more than 60 inches.

This soil has a high available water capacity. Permeability is moderate, and surface runoff is slow. This soil has good tilth and a deep root zone that is easily penetrated.

Included with this soil in mapping are small areas of Garvin and Bergstrom soils. The Garvin soils occur in depressional areas. These included soils make up about 10 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Elandco soil are used for crops. A few areas are used for tame pasture and hay.

This soil has high potential for crops. It is primarily used for alfalfa and wheat. Maintenance of soil fertility and desirable structure are the main concerns of soil management. Changing tillage depth and tilling at a time when least compaction would occur will help maintain good soil structure and reduce the chances of a tillage pan forming. High soil fertility can be maintained by returning large amounts of crop residue to the soil and applying adequate kinds and amounts of fertilizer on a yearly basis.

The potential is high for native grasses, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods can help to keep the grass and soil in good condition.

The potential for urban uses is low because of the flood hazard. The risk of damaging floods is the main limitation. Upstream flood-control measures, however, have lessened this risk, but flooding is still a possibility.

This soil is in capability subclass IIw and in the Loamy Bottomland range site.

22—Galey loamy fine sand, 1 to 3 percent slopes. This deep, moderately well drained, very gently sloping soil is on broad ridgetops of uplands. Individual areas are 10 to 80 acres.

Typically, the surface layer is grayish brown loamy fine sand that extends to a depth of 8 inches. The subsurface layer is light brownish gray loamy fine sand that extends to a depth of 12 inches. The upper part of the subsoil is brown sandy clay loam that extends to a depth of 31 inches. The middle part of the subsoil is strong brown, mottled sandy clay loam that extends to a depth of 45 inches. The lower part of the subsoil is reddish yellow, mottled sandy clay loam to a depth of 60 inches.

This soil has a medium available water capacity. Permeability is moderate, and surface runoff is slow. The water table is perched between depths of 4 and 6 feet in the winter and spring. This soil can be worked through a wide range of moisture conditions, but it is subject to soil blowing if not protected. The root zone is deep and easily penetrated.

Included in mapping are small areas of Konawa soils on side slopes and soils similar to the Galey soil except that they are redder in the upper part of the subsoil. Also included are soils similar to the Galey soil except that they have a surface layer more than 20 inches thick. These included soils make up about 35 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Galey soil are used for orchards and tame pasture. Some areas are used for crops and a small acreage is used for range.

This soil has medium potential for most crops. It has high potential for peanuts and fruit crops. The main concerns of management include a moderate hazard of erosion by wind and water and maintaining soil tilth, soil fertility, and soil moisture. Ample crop residues worked lightly into the surface, minimum tillage, and contour tillage are ways to reduce soil losses by wind and water erosion. This also helps to conserve soil moisture and maintain soil tilth when crops are grown. Utilizing cover crops or grasses and legumes in the crop rotation are additional ways to reduce erosion losses. Crops, pasture, or hay will respond favorably to applications of fertilizers.

The potential is medium for native grasses, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing the grass when the soil is too wet will cause excessive runoff. Proper stocking rates, rotation of grazing, timely deferment of grazing, and restricted use during wet periods can help keep the grass and soil in good condition.

This soil has high potential for most building sites. Seepage is a limitation in areas where the soil is used for sewage lagoons. This may be corrected at time of construction by covering the bottom and lower side slopes with material that is more clayey.

This soil is in capability subclass IIIe and in the Deep Sand Savannah range site.

23—Garvin silty clay loam, occasionally flooded. This deep, moderately well drained, nearly level soil is on flood plains of local streams that are occasionally flooded. Slopes range from 0 to 1 percent. Individual areas are 5 to 150 acres.

Typically, the surface layer is very dark gray silty clay loam that extends to a depth of about 9 inches thick. The next layer is black silty clay that extends to a depth of about 32 inches. The subsoil is reddish brown clay loam that extends to a depth of 65 inches. The underlying material is dark reddish gray clay to a depth of more than 74 inches.

This soil has a high available water capacity. Permeability is very slow, and surface runoff is slow. Tillage is limited by the silty clay loam texture and slow runoff. This soil cracks during dry periods.

Included with this soil in mapping are soils next to the stream channel that have a fine sandy loam surface layer 6 to 16 inches thick. Also included are a few areas of Elandco soils next to the stream channel. These included soils make up about 20 percent of the unit, but individual areas are generally less than 5 acres.

This Garvin soil is used mainly for crops. Some areas are used for tame pasture.

This soil has high potential for crops. It is used primarily for wheat, alfalfa, and grain sorghum. Maintenance of soil fertility and desirable structure are the main concerns of management. In some areas surface drainage is a problem. Changing tillage depth and tilling at a time when least compaction would occur will help maintain good soil structure and reduce the chances of a tillage pan forming. Simple drainage and proper row direction can help remove surplus water. High soil fertility can be maintained by returning large amounts of crop residue to the soil and applying adequate kinds and amounts of fertilizer on a yearly basis.

The potential is high for range, tame pasture, and hay. Bermudagrass, fescue, and King Ranch or plains bluestem are the main plants used for tame pasture. Proper stocking rates, rotation of grazing, timely deferment of grazing, and restricted use during wet periods help to keep the grass and soil in good condition.

This soil has low potential for most urban uses. Most of the properties of this soil are unfavorable for building sites because of flooding and a high shrink-swell potential. These problems are difficult to correct.

This soil is in capability class IIIw and in the Heavy Bottomland range site.

24—Garvin and Elandco soils, frequently flooded. This map unit consists of deep, moderately well drained to well drained, nearly level Garvin and Elandco soils on narrow, meandering flood plains that are frequently flooded. Slopes are smooth to concave and range from 0 to 1 percent. The pattern and extent of Garvin and Elandco soils are not uniform. Some areas consist mostly of Garvin silty clay, but most areas contain both Garvin and Elandco soils. Individual areas are 5 to 45 acres.

The Garvin soils make up about 55 percent of most mapped areas. Typically, the surface layer is dark gray silty clay that extends to a depth of about 10 inches. The next layer is very dark gray clay that extends to a depth of 30 inches. The subsoil is dark brown clay that extends to a depth of 44 inches. The underlying material is reddish brown clay to a depth of 72 inches.

Garvin soils have a high available water capacity. Permeability is very slow, and surface runoff is slow. These soils develop wide cracks during prolonged dry periods because of the high clay content. The root zone is deep, but the clayey subsoil restricts root growth.

The Elandco soils make up about 30 percent of most mapped areas. Typically, the surface layer is dark grayish brown silt loam that extends to a depth of 15 inches. The next layer is very dark grayish brown silty clay loam that extends to a depth of 35 inches. The underlying material is brown silty clay loam to a depth of about 60 inches.

Elandco soils have a high available water capacity. Permeability is moderate, and surface runoff is slow. The root zone is deep and easily penetrated by plant roots.

Included with these soils in mapping are small areas of soils, near stream channels, that have a sandy clay loam subsoil. Also included, in the tributaries draining into the southside of Wildhorse Creek, are small areas of soils that have limestone cobbles about 5 feet below the surface. These soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

The potential is low for cultivated crops. Frequent flooding is a major hazard for cultivated crops, and it can cause soil damage and loss of crops. This unit is best suited to grass or trees.

The soils in this unit have high potential for grasses and trees. These soils are used mainly for native grasses and tame pastures. Bermudagrass, tall fescue, and King Ranch or plains bluestem are the main plants used for tame pasture. Considerable acreages are in trees. The main concern of management is the frequent flooding. These soils produce good hardwoods where trees are thinned, weeded, and selectively harvested. Pecan production is generally dependable under good management practices. Fertilizing and proper grazing of tame pasture plants are desirable practices to help control erosion by flooding. Brush control is needed to obtain high yields.

This unit has low potential for most urban uses. The frequent flooding of these soil severely limits their urban use. Flooding is the main limitation for septic tank absorption fields, sewage lagoons, trench sanitary landfills, dwellings, buildings, roads, and streets. This limitation can be reduced by major flood-control measures.

The soils in this map unit are in capability subclass Vw. The Garvin soils are in the Heavy Bottomland range site; the Elandco soils are in the Loamy Bottomland range site.

25—Gracemont fine sandy loam, occasionally flooded. This deep, somewhat poorly drained, nearly level soil is on flood plains that are occasionally flooded. Slopes range from 0 to 1 percent, and are usually smooth to concave. During the winter and spring the water table is within 6 to 36 inches of the surface. During wet periods it is commonly within 20 inches of the surface. Mapped areas are 10 to 200 acres.

Typically, the surface layer is brown fine sandy loam that extends to a depth of 7 inches. The upper part of the underlying material extends to a depth of 29 inches and is light brown fine sandy loam stratified with thin layers of loamy fine sand and fine sand. The middle part of the underlying material extends to a depth of 47 inches and is reddish brown fine sandy loam stratified with thin layers of loam and loamy fine sand. The lower part of the underlying material is reddish brown clay loam stratified with thin layers of fine sandy loam and fine sand to a depth of 70 inches.

This soil has a high available water capacity. Permeability is moderate, and surface runoff is slow.

Included with this soil in mapping are small areas of soils similar to the Gracemont soil except that they are noncalcareous at depths of 10 to 40 inches below the surface and small areas of soils that have a more clayey subsoil. Also included are small areas of soils similar to the Port soil except that they have a high water table. These included soils make up about 30 percent of the unit, but individual areas are generally less than 5 acres.

This Gracemont soil is used mainly for tame pasture and hay, but some areas are used for crops. A few areas are used for range.

This soil has medium potential for crops. It is used mainly for wheat and grain sorghum. Maintaining or improving soil fertility, controlling floods, and lowering the water table on cultivated areas are the main concerns of management. Growing crops that are high in residue, returning the residue to the soil, and adding adequate amounts of fertilizer will maintain or increase soil fertility. Flooding can be reduced by placing watershed protection projects upstream. Straightening and deepening the stream channel on a community basis help lower the water table where it is a problem.

Potential is high for range, tame pasture, and hay. Bermudagrass, weeping lovegrass, King Ranch bluestem, and plains bluestem grass are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing when the soil is too wet will cause excessive compaction. Proper stocking rates, rotation of grazing, timely deferment of grazing, and restricted use during wet periods help to keep the grass and soil in good condition.

Because of the risk of damaging floods, this soil should not be considered as having potential for residential and urban building sites. Flooding is the main limitation for septic tank absorption fields, sewage lagoons, trench sanitary landfills, roads, and streets. This limitation can be reduced only by major flood-control measures.

This soil is in capability subclass IIIw and in the Subirrigated range site.

26—Grainola clay loam, 2 to 5 percent slopes. This moderately deep, well drained, very gently sloping to gently sloping soil is on smooth ridge divides and side slopes of uplands. Individual areas are 10 to 60 acres.

Typically, the surface layer is reddish brown clay loam that extends to a depth of 7 inches. The subsoil is red, calcareous clay that extends to a depth of 38 inches. The underlying material is red and light gray, calcareous shale to a depth of more than 60 inches.

The soil has a high available water capacity. Permeability is slow, and surface runoff is medium. There is a limited range of moisture conditions when this soil can be properly tilled, and pasture grasses may be difficult to establish. This soil cracks severely during prolonged dry periods. The root zone is moderately deep.

Included with this soil in mapping are small areas of Renfrow and Zanies soils. These included soils make up about 5 to 10 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Grainola soil are used for range. A small acreage is used for tame pasture or crops.

This soil has a low potential for crops. Where this soil is cultivated, wheat and grain sorghum are grown. Erosion is a hazard if this soil is cultivated. Minimum tillage, use of fertilizer, high residue use, growing grasses and legumes in the cropping system, and installing a terrace system are practices that can help reduce runoff, control water erosion, and increase soil fertility.

The potential is medium for native grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay is effective for controlling erosion. Overgrazing or grazing when the soil is too wet will cause surface crusting and excessive runoff. Proper stocking rates, rotation of grazing, timely deferment of grazing, and restricted use during wet periods help to keep the grass and soil in good condition.

This soil has low potential for most urban uses. It has a high shrink-swell potential and slow permeability. Building development on the soil requires special engineering designs to overcome these limitations.

This soil is in capability subclass IVe and in the Shallow Prairie range site.

27—Grainola clay loam, 5 to 20 percent slopes. This moderately deep, well drained, sloping to moderately steep soil is on narrow ridge crests and dissected side slopes of uplands. Individual areas are 10 to 80 acres.

Typically, the surface layer is reddish brown clay loam that extends to a depth of 5 inches. The subsoil is red clay that extends to a depth of 35 inches. The underlying material is red shale bedrock to a depth of more than 60 inches.

This soil has a high available water capacity. Permeability is slow, and surface runoff is medium to rapid. The root zone is moderately deep.

Included with this soil in mapping are small areas of Renfrow and Clarita soils. Also included are small areas of gullied soils and escarpments. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Grainola soil are used for range. A small acreage is in tame pasture.

The soil is not suited to crops. The moderately steep slope is a limitation that is very difficult to overcome.

This soil has medium potential for producing native grasses. Management problems include protecting native grasses from overgrazing and burning. Encroachment of brush and weeds is a problem on poorly managed areas.

The potential is low for tame pasture and hay. The moderately steep slopes and the exposed escarpment areas limit the potential for tame pasture and hay. Tame pasture is effective for controlling erosion. Proper stocking rates, rotation of grazing, timely deferment of grazing, and restricted use during wet periods help to keep the grass and soil in good condition.

This soil has a low potential for most urban uses. Building sites on this soil are hampered by the moderately steep slopes and a high shrink-swell potential.

This soil is in capability subclass VIe and in the Shallow Prairie range site.

28—Grainola cobbly clay loam, 5 to 20 percent slopes, eroded. This moderately deep, well drained, sloping to moderately steep eroded soil is on narrow ridge crests and dissected convex side slopes of the uplands at the base of the Arbuckle Mountains. Limestone cobbles cover about 25 percent of the area. Mapped areas are 10 to 80 acres.

Typically, the surface layer is reddish brown cobbly clay loam that extends to a depth of about 6 inches. The subsoil is red clay that extends to a depth of 26 inches. The underlying material is reddish brown, rippable shale to a depth of more than 60 inches.

This soil has a high to medium available water capacity. Permeability is slow, and surface runoff is medium to rapid. The root zone is moderately deep. This soil has poor tilth because of the cobbles and clay content.

Included with this soil in mapping are small areas of Rayford soils at higher elevations. Also included are small areas of exposed escarpment, areas of eroded soils that have little or no surface layer, and areas of soils similar to the Grainola soil except that they have a cobbly subsoil. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Grainola soil are used for range. A small acreage is in tame pasture.

The soil is not suited to crops. The moderately steep slopes and the cobbles are the main limitations and are very difficult to overcome.

This soil has medium potential for producing native grasses. Management problems include protecting native grasses from overgrazing and burning. Encroachment of brush and weeds is a problem on poorly managed areas.

Potential is low for tame pasture and hay. The moderately steep slopes, cobbles, and the exposed escarpment areas restrict the soil potential for tame pasture and hay. Proper stocking rates, rotation of grazing, timely deferment of grazing, and restricted use during wet periods can help to keep the grass and soil in good condition.

This soil has low potential for most urban uses. Building sites on this soil are hampered by the moderately steep slopes and a high shrink-swell potential.

This soil is in capability subclass VIIs and in the Shallow Prairie range site.

29—Grainola-Urban land complex, 2 to 8 percent slopes. This complex consists of moderately deep, well drained soils and areas of Urban land on very gently sloping to sloping prairie uplands. Urban land is used for buildings, streets, houses, and roads. Areas of these soils and Urban land are so intermingled that it was not practical to separate them at the scale selected for mapping.

The Grainola soils make up 40 percent of the unit. Typically, the surface layer is reddish brown clay loam that extends to a depth of about 7 inches. The subsoil is red calcareous clay that extends to a depth of 38 inches. The underlying material is red, calcareous shale bedrock to a depth of more than 60 inches.

Grainola soils have a high available water capacity. Permeability is slow, and surface runoff is rapid.

In about 30 percent of the acreage of this map unit the Grainola soils have been modified by excavating, filling, and grading. In excavated and filled areas, the surface layer is a mixture of loamy and clayey material. The loamy fill material has been hauled from other areas.

Urban land makes up about 30 percent of the unit. It is used for buildings, streets, houses, and roads. Urban land has very rapid surface runoff.

Included in mapping are small areas of Renfrow and Zaneis soils. These included soils make up about 30 percent of the unit.

This complex is used mostly for urban development, including industrial sites. The main concerns in using this complex as urban areas are the slow permeability, the slope, a high shrink-swell potential, and the clayey soil texture (fig. 5). The Grainola soil is moderately suited to lawn grasses, flowers, most shrubs, and garden plants. It has limitations for playgrounds, paths, and trails in recreational areas. This complex has severe limitations for dwellings, septic tank absorption fields, commercial buildings, sewage lagoons, roads, and streets because of the soil depth, slow permeability, and high shrink-swell potential. The clayey texture of the soil and high alkalinity of the subsoil is highly corrosive on uncoated steel.

No capability subclass or range site has been assigned to this complex.

Figure 5.—Excessive erosion can occur on Grainola soils after vegetation is removed for urban development.

30—Justin loam, 0 to 1 percent slopes. This deep, well drained, nearly level soil is on broad, smooth ridgetops of the uplands. Slopes are smooth and slightly convex. Individual areas are 5 to more than 200 acres.

Typically, the surface layer is dark grayish brown loam that extends to a depth of about 14 inches. The upper part of the subsoil is grayish brown clay loam that extends to a depth of 24 inches. The middle part is strong brown clay loam that extends to a depth of 44 inches. The lower part of the subsoil is brown, mottled clay loam to a depth of 72 inches.

This soil has a high available water capacity. Permeability is moderately slow, and surface runoff is slow. This soil has good tilth and can be worked over a wide range of moisture conditions. The root zone is deep and easily penetrated by moisture and roots.

Included with this soil in mapping are small areas of Durant soils and soils similar to the Justin loam except that they have a more clayey subsoil. These included soils make up about 10 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Justin soil are used for crops. Some areas are used for tame pasture and hay. A few areas are used for orchards.

This soil has high potential for crops. Irrigation is available for most of the acreage. This soil is used mainly for wheat, cotton, grain sorghums, peanuts, and corn. Important management practices on this soil are those that maintain soil structure and fertility. Returning crop residue to the soil and annually applying fertilizer are important for the maintenance of high fertility on cropland. Timely tillage under proper moisture conditions helps maintain good soil structure.

The potential is high for native grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing when the soil is too wet causes puddling and destroys soil structure. Proper stocking rates, rotation of grazing, timely deferment of grazing, and restricted use during wet periods help to keep the grass and soil in good condition.

This soil has medium potential for most urban uses. The moderately slow permeability is the main limitation for septic tank absorption fields, but this can be overcome by increasing the size of the absorption area. A potential for shrinking and swelling is a limitation for building development.

This soil is in capability class I and in the Loamy Prairie range site.

31—Justin loam, 1 to 3 percent slopes. This deep, well drained, very gently sloping soil is on broad, smooth ridgetops and side slopes of the uplands. Slopes are smooth and convex. Individual areas are 10 to 160 acres.

Typically, the surface layer is dark grayish brown loam that extends to a depth of about 12 inches. The upper part of the subsoil is grayish brown, mottled clay loam that extends to a depth of 20 inches. The middle part is light brownish gray, mottled clay loam that extends to a depth of 45 inches. The lower part of the subsoil is pale brown, mottled clay loam to a depth of 72 inches.

This soil has a high available water capacity. Permeability is moderately slow, and surface runoff is medium. This soil has good tilth and can be worked over a wide range of moisture conditions. The root zone is deep and easily penetrated by moisture and roots.

Included with this soil in mapping are small areas of Durant soils and soils similar to the Justin soil except that the subsoil is more clayey in the lower part. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Justin soil are used for crops. Some areas are used for tame pasture and hay. A small acreage is used for orchards.

This soil has high potential for crops. Irrigation is available for most of the acreage. This soil is used mainly for wheat, cotton, grain sorghum, peanuts, and corn. Controlling erosion and maintaining desirable soil structure and fertility are the main concerns of soil management. Water erosion can be controlled by keeping adequate cover of crop residue on the soil surface. Where this cover is not adequate to control water erosion, terraces are needed. Timely tillage under proper moisture conditions helps maintain good soil structure. Additional fertilizer should be applied where crop residue is returned to the soil or left on the surface.

The potential is high for native grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing when the soil is too wet will cause crusting and excessive runoff. Proper stocking rates, rotation of grazing, timely deferment of grazing, and restricted use during wet periods can help to keep the grass and soil in good condition.

This soil has medium potential for most urban uses. It has limitations for septic tank absorption fields because of the moderately slow permeability. This limitation can be corrected by using a lagoon system, increasing the size of the absorption field, or modifying the field. A good foundation is needed for buildings because of a moderate shrink-swell potential of this soil.

This soil is in capability subclass IIe and in the Loamy Prairie range site.

32—Keokuk silt loam, rarely flooded. This deep, well drained, nearly level soil is on flood plains that are rarely flooded. Slopes are smooth and slightly convex and range from 0 to 1 percent. Individual areas are 25 to 350 acres.

Typically, the surface layer is dark brown silt loam that extends to a depth of about 8 inches. The next layer is reddish brown silt loam that extends to a depth of 16 inches. The subsoil is red silt loam that extends to a depth of 48 inches. The underlying material is red, stratified very fine sandy loam to a depth of more than 80 inches.

This soil has a high available water capacity. Permeability is moderate, and surface runoff is slow. This soil has good tilth and can be worked over a wide range of moisture conditions.

Included with this soil in mapping are small areas of Dale soils on the same landscape as Keokuk soils and soils that are similar to the Keokuk except that they have a dark surface layer more than 20 inches thick. These included soils make up about 20 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Keokuk soil are used for crops. Some areas are used for tame pasture and hay.

This soil has high potential for crops. It is primarily used to grow alfalfa (fig. 6), grain sorghum, and wheat. Some areas are used for cotton (fig. 7), soybeans, and corn. Maintenance of soil fertility and desirable structure are prime concerns of soil management. Changing tillage depth and tilling at a time when least compaction would occur will help maintain good soil structure and reduce the chances of a tillage pan forming. High soil fertility can be maintained by returning large amounts of crop residue to the soil and applying adequate kinds and amounts of fertilizer on a yearly basis.

The potential is high for tame pasture and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods can help to keep the grass and soil in good condition.

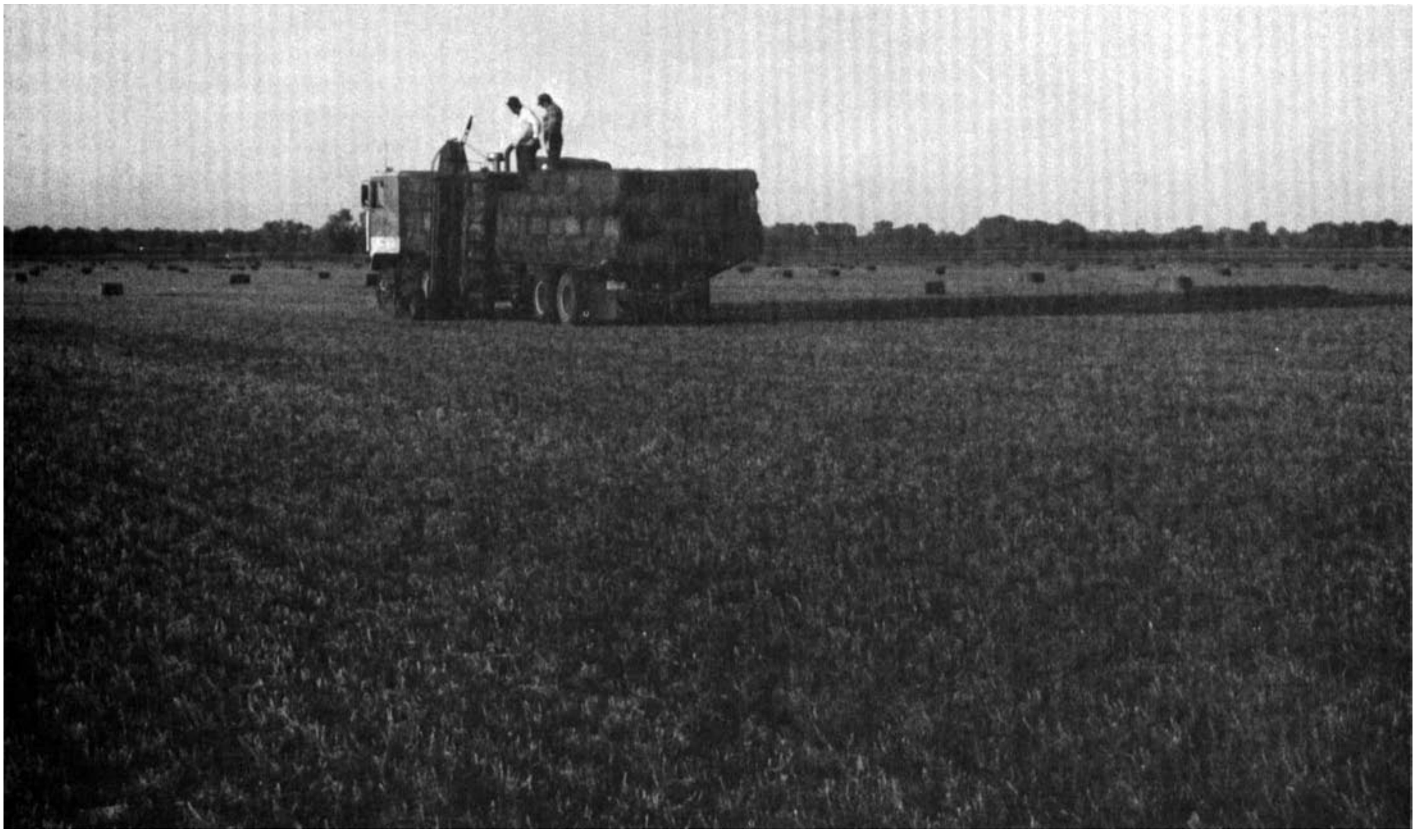

Figure 6.—Alfalfa on Keokuk silt loam, rarely flooded.

This soil has low potential for most urban uses. Most properties of this soil are favorable for building sites although this soil is subject to rare flooding.

This soil is in capability class I and in the Loamy Bottomland range site.

33—Keokuk-Urban land complex, rarely flooded. This complex consists of deep, well drained soils and areas of Urban land on nearly level flood plains that are rarely flooded. Urban land is used for buildings, streets, houses, and roads. Areas of these soils and Urban land are so intermingled that it was not practical to separate them at the scale selected for mapping.

The Keokuk soils make up 45 percent of the unit. Typically, the surface layer is dark brown silt loam that extends to a depth of 8 inches. The next layer is reddish brown silt loam that extends to a depth of 16 inches. The subsoil is red silt loam that extends to a depth of 48 inches. The underlying material is red, stratified very fine sandy loam to a depth of about 80 inches.

Keokuk soils have a high available water capacity. Permeability is moderate, and surface runoff is slow.

In about 30 percent of the acreage of this map unit the Keokuk soils have been modified by excavating, filling, and grading. In excavated and filled areas, the surface layer is a mixture of loamy, silty, and sandy material.

Urban land makes up about 20 percent of the unit. It is used for buildings, streets, houses, and roads. Urban land has very rapid surface runoff.

Included in mapping are small areas of Asher, Dale, and McLain soils. These included soils make up about 35 percent of the unit.

This complex is used mostly for urban development, picnic areas, playgrounds, houses, roads, and streets. The main concern of using this complex in urban areas is flooding. The Keokuk soil is well suited to trees, shrubs, flowers, lawn grasses, and garden plants. It has no significant limitations for picnic areas, paths, playgrounds, and trails. Flooding is the main concern for camp areas, septic tank absorption fields, sanitary landfill areas, roads, streets, dwellings, and commercial buildings.

No capability subclass or range site has been assigned to this complex.

Figure 7.—Cotton on Keokuk silt loam, rarely flooded, and Dale silt loam, rarely flooded.

34—Konawa loamy fine sand, 3 to 8 percent slopes. This deep, well drained, gently sloping to sloping soil is on narrow ridgetops and smooth side slopes of high stream terraces. Individual areas are 10 to 160 acres.

Typically, the surface layer is pinkish gray loamy fine sand about 6 inches thick. The subsurface layer is pinkish gray loamy fine sand that extends to a depth of 16 inches. The upper part of the subsoil is yellowish red sandy clay loam that extends to a depth of 45 inches. The lower part of the subsoil is reddish yellow fine sandy loam that extends to a depth of 58 inches. The underlying material is reddish yellow fine sandy loam to a depth of about 72 inches.

This soil has a medium available water capacity. Permeability is moderate, and surface runoff is moderate. This soil is easily penetrated by plant roots and can be tilled through a wide range of moisture conditions. It is subject to soil blowing when left without adequate protection.

Included with this soil in mapping are small areas of Galey soils and soils similar to the Konawa soil except that the surface layer of loamy fine sand is more than 20 inches thick. These included soils make up about 10 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Konawa soil are used for fruit and vegetable crops, tame pasture, and hay. Some areas are used for range and crops.

This soil has medium potential for crops. It has high potential for orchards. The main limitation for crops is the severe erosion hazard. Growing cover crops helps control erosion in orchards and row crops. Where small grains or other crops are grown, high levels of residue should be maintained as a mulch and worked lightly into the surface layer to help prevent soil blowing and maintain good tilth. The use of fertilizers helps to increase production of crop residues and forage of tame pasture plants.

The potential is medium for native grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods can help to keep the grass and soil in good condition.

This soil has high potential for most urban uses. Seepage is the main limitation for sewage lagoons or trench type sanitary landfills, and slope is the main limitation for small commercial buildings. For most uses, these limitations can be overcome through proper design or special engineering practices at time of construction.

This soil is in capability subclass IVe and in the Deep Sand Savannah range site.

35—Konawa loamy fine sand, 3 to 8 percent slopes, eroded. This deep, well drained, gently sloping to sloping, eroded soil is on narrow ridgetops and side slopes of high stream terraces. The surface layer has been thinned by erosion. The reddish subsoil has been exposed by plowing on 25 to 50 percent of the area. On an additional 50 percent of the area, more than half of the original surface layer has been removed by erosion. Occasional gullies are present in some areas. Individual areas are 10 to 100 acres.

Typically, the surface layer is pale brown loamy fine sand that extends to a depth of about 5 inches. The upper part of the subsoil is yellowish red sandy clay loam that extends to a depth of 45 inches. The lower part of the subsoil is reddish yellow fine sandy loam that extends to a depth of about 60 inches.

This soil has a medium available water capacity. Permeability is moderate, and surface runoff is moderate. This soil has fair tilth and can be tilled through a wide range of moisture conditions. The erosion hazard is severe where the soil is clean tilled.

Included with this soil in mapping are small areas of soils similar to the Konawa soil except that they have a yellowish brown subsoil. Also included are soils in small areas that are not eroded. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Most of the acreage of this Konawa soil is used for tame pasture and hay. Some areas are used for crops, and a small acreage is used for range. A few areas are used for fruit and vegetable crops.

This soil has medium potential for crops. It is well suited to orchards. The main limitations for crops are the severe erosion hazard and low fertility. Using cover crops, returning maximum amounts of crop residue to the soil, and contour farming help reduce runoff and erosion. Supplying adequate amounts of fertilizer also helps to provide additional plant residues. Growing cover crops helps control wind erosion during the winter and early in spring.

The potential is medium for range grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing the pasture when the soil is too wet will cause surface compaction and excessive runoff. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods can help to keep the grass and soil in good condition.

This soil has high potential for most urban uses. Seepage is the main limitation for sewage lagoons or trench type sanitary landfills, and slope is the main limitation for small commercial buildings. Most of these limitations can be overcome through proper design or special engineering practices at time of construction.

This soil is in capability subclass IVe and in the Deep Sand Savannah range site.

36—Konawa loamy fine sand, 3 to 8 percent slopes, gullied. This deep, well drained, gently sloping to sloping, gullied soil is on side slopes of high stream terraces. Individual areas are 5 to 80 acres.

Gullies caused by water erosion are 15 to 40 feet in width, 3 to 12 feet in depth, and 100 to 500 feet apart. Most of the original surface layer has been removed by erosion in about 60 percent of the area. In about 20 percent of the mapped area the surface layer has been mixed with the subsoil by tillage. The surface layer between the gullies averages about 5 inches thick. Gullies make up about 8 percent of the unit.

Typically, the surface layer is brown loamy fine sand that extends to a depth of about 4 inches. The upper part of the subsoil is red sandy clay loam that extends to a depth of 44 inches. The lower part of the subsoil is light red fine sandy loam to a depth of about 60 inches.

This soil has a medium available water capacity. Permeability is moderate, and surface runoff is moderate to rapid. The root zone is deep and easily penetrated by plant roots. The erosion hazard is severe and proper conservation practices are needed to prevent further erosion.

Included with this soil in mapping are small areas of Konawa soils that have a fine sandy loam surface layer. These included soils make up 20 percent of the unit, but individual areas are generally less than 5 acres.

This soil is used mostly for range. A few areas are used for tame pasture.

This soil is generally not suitable for cultivated crops. The main concerns in management are protecting the soil from additional erosion and improving soil fertility. Fertilizing tame pasture and legumes for maximum residue production helps to reduce soil erosion and maintain fertility. Runoff from higher areas should be diverted and banks of gullies shaped before establishing a permanent cover in most areas.

The potential is medium for native grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture is effective for controlling erosion. Renovating and planting grass in gullied areas help control erosion. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods help to keep the grass and soil in good condition.

This soil has medium potential for most urban uses. Soil limitations include the gullied areas and little or no topsoil over much of the area. This unit requires land shaping and smoothing with extensive cuts and fills. Most community facilities can be designed to overcome these limitations by special engineering practices.

This soil is in capability subclass VIe and in the Eroded Sandy Savannah range site.

37—Konawa loamy fine sand, 8 to 20 percent slopes. This deep, well drained, strongly sloping to moderately steep soil is on narrow ridgetops and side slopes of high stream terraces. Individual areas are 10 to 60 acres.

Typically, the surface layer is brown loamy fine sand that extends to a depth of about 8 inches. The subsurface layer is very pale brown loamy fine sand that extends to a depth of about 12 inches. The upper part of the subsoil is yellowish red sandy clay loam that extends to a depth of 38 inches. The lower part of the subsoil is reddish yellow sandy clay loam that extends to a depth of 54 inches. The underlying material is reddish yellow fine sandy loam to a depth of about 72 inches.

This soil has medium available water capacity. Permeability is moderate, and surface runoff is medium. This soil is easily penetrated by plant roots. It is subject to soil blowing when left without adequate protection.

Included with this soil in mapping are small areas of soils similar to the Konawa soils except that they have a surface layer of loamy fine sand that is more than 20 inches deep. These included soils make up about 10 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Konawa soil are used for native range, and a small acreage is used for tame pasture. This soil is unsuited to crops because of the slopes.

The potential is medium for native grass, tame pasture, and hay. Tame pasture and hay are effective for controlling erosion. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during periods of drought help to keep the grass and soil in good condition.

This soil has medium potential for most urban uses. The slope and seepage are the main limitations for sewage lagoons and trench type sanitary landfills. Most of these limitations can be overcome through proper design or special engineering practices at time of construction.

This soil is in capability subclass VIe and in the Deep Sand Savannah range site.

38—Konawa fine sandy loam, 1 to 3 percent slopes. This deep, well drained, very gently sloping soil is on broad ridgetops of high stream terraces. Slopes are smooth and convex. Individual areas are 10 to 80 acres.

Typically, the surface layer is brown fine sandy loam that extends to a depth of 8 inches. The subsurface layer is light brown fine sandy loam that extends to a depth of about 12 inches. The upper part of the subsoil is reddish brown sandy clay loam that extends to a depth of 34 inches. The lower part of the subsoil is yellowish red sandy clay loam that extends to a depth of 62 inches. The underlying material is reddish yellow fine sandy loam to a depth of 72 inches.

This soil has a medium available water capacity. Permeability is moderate, and surface runoff is slow. This soil can be worked through a wide range of moisture conditions. The root zone is deep and easily penetrated.

Included in mapping are small areas of soils similar to the Konawa soil except that the subsoil does not decrease in clay content in the lower part, or the subsoil has pale brown and light brownish gray mottles in the lower part. These included soils make up about 15 percent of the unit, but individual areas generally are less than 5 acres.

Most areas of this soil are used for crops and tame pasture. Some areas are used for range.

This soil has high potential for crops. Wheat and grain sorghum are the main crops. This soil has high potential for orchards. The main concerns of management include a moderate hazard of erosion by wind and water and maintaining soil tilth, soil fertility, and soil moisture. Ample crop residues worked into the surface layer, minimum tillage, and contour tillage are ways to reduce soil losses by wind and water erosion. Residue also helps to conserve soil moisture and maintain soil tilth when crops are grown. Utilizing cover crops or grasses and legumes in the crop rotation are additional ways to reduce erosion losses. Crops, tame pasture, or hay will respond favorably to applications of ferilizers.

The potential is medium for native grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing the grasses when the soil is too wet will cause surface crusting and excessive runoff. Proper stocking rates, pasture rotation of grazing, timely deferment of grazing, and restricted use during wet periods can help keep the grass and soil in good condition.

This soil has high potential for most urban uses. Seepage is severe in areas where the soil is used for sewage lagoons or trench type sanitary landfills. This may be corrected at the time of construction by covering the bottom and lower side slopes with material that is more clayey.

This soil is in capability subclass IIe and in the Sandy Savannah range site.

39—Konawa fine sandy loam, 2 to 5 percent slopes, eroded. This deep, well drained, very gently sloping to gently sloping, eroded soil is on narrow ridgetops and side slopes of high stream terraces. The surface layer has been thinned by erosion. The reddish subsoil has been exposed by plowing on about 25 to 50 percent of the area. On an additional 50 percent of the area, more than half of the original surface layer has been removed by erosion. Occasional gullies are present in some areas. Individual areas are 10 to 100 acres.

Typically, the surface layer is reddish brown fine sandy loam that extends to a depth of about 3 inches. The upper part of the subsoil is yellowish red sandy clay loam that extends to a depth of 32 inches. The lower part of the subsoil is reddish yellow fine sandy loam to a depth of about 70 inches.

This soil has a medium available water capacity. Permeability is moderate, and surface runoff is moderate to rapid. This soil can be worked through a wide range of moisture conditions. The erosion hazard is severe where the soil is clean tilled.

Included with this soil in mapping are small areas of soils similar to the Konawa soil except that they have a yellowish brown subsoil. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Most of the acreage of this Konawa soil is used for tame pasture and hay. Some areas are used for crops and a small acreage is used for range. A few areas are used for fruit and vegetable crops.

This soil has low potential for crops. It is well suited to orchards. The main limitations for crops are the low fertility levels and severe erosion hazard. Using cover crops, returning maximum amounts of crop residue to the soil, and contour farming help reduce runoff and erosion. Supplying adequate amounts of fertilizer also helps to provide additional plant residues. Growing cover crops helps control wind erosion during the winter and early in spring.

The potential is medium for tame pasture and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing the tame pasture grasses when the soil is too wet will cause surface compaction and excessive runoff. Proper stocking rates, rotation of grazing, deferred grazing; and restricted use during wet periods help to keep the grass and soil in good condition.

This soil has high potential for most urban uses. Seepage is the main limitation for sewage lagoons or trench type sanitary landfills, and slope is the main limitation for small commercial buildings. Most of these limitations can be overcome through proper design or special engineering practices at time of construction.

This soil is in capability subclass IIIe and in the Sandy Savannah range site.

40—Konawa fine sandy loam, 5 to 8 percent slopes. This deep, well drained, sloping soil is on narrow ridgetops and side slopes of high stream terraces. Individual areas are 10 to 80 acres.

Typically, the surface layer is brown fine sandy loam that extends to a depth of about 7 inches. The upper part of the subsoil is yellowish red sandy clay loam that extends to a depth of 50 inches. The lower part of the subsoil is reddish yellow fine sandy loam to a depth of about 70 inches.

This soil has a medium available water capacity. Permeability is moderate, and surface runoff is moderate. This soil can be worked through a wide range of moisture conditions. The erosion hazard is severe where the soil is clean tilled.

Included with this soil in mapping are small areas of soils similar to the Konawa soil except that they have a surface layer of loamy fine sand. Also included are small areas of soils similar to the Konawa soil except that the subsoil is yellowish brown. These included soils make up about 10 percent of the unit, but individual areas are generally less than 5 acres.

Most of the acreage of this Konawa soil is used for tame pasture and hay. A small acreage is used for crops and some for range. A few areas are used for fruit and vegetable crops.

This soil has low potential for crops. It is well suited to orchards. The main limitation for crops is the severe erosion hazard due to the slope. Using cover crops, returning maximum amounts of crop residue to the soil, and contour farming help reduce runoff and erosion. Applying adequate amounts of fertilizer also helps to provide additional plant residues. Growing cover crops helps control wind erosion during the winter and early in spring.

The potential is medium for tame pasture and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing the pasture when the soil is too wet will cause surface compaction and excessive runoff. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods can help keep the grass and soil in good condition.

This soil has high potential for most urban uses. Seepage is the main limitation for sewage lagoons or trench type sanitary landfills, and slope is the main limitation for small commercial buildings. Most of these limitations can be overcome through proper design or special engineering practices at the time of construction.

This soil is in capability subclass IVe and in the Sandy Savannah range site.

41—Konsil loamy fine sand, 0 to 3 percent slopes. This deep, well drained, nearly level to gently sloping soil is on broad ridgetops of uplands. Individual areas are 10 to 250 acres.

Typically, the surface layer is brown loamy fine sand that extends to a depth of 10 inches. The upper part of the subsoil is yellowish red sandy clay loam that extends to a depth of 28 inches. The middle part of the subsoil is reddish yellow sandy clay loam that extends to a depth of 50 inches. The lower part of the subsoil is yellowish red fine sandy loam that extends to a depth of 60 inches. The underlying material is yellowish red, weakly cemented sandstone to a depth of 64 inches or more.

This soil has a medium available water capacity. Permeability is moderate, and surface runoff is slow. This soil can be worked through a wide range of moisture conditions but is subject to soil blowing if it is not protected. The root zone is deep and easily penetrated by roots.

Included with this soil in mapping are intermingled areas of soils in which the subsoil layer is brownish in the upper part; otherwise they have a profile similar to the profile of this Konsil soil. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Konsil soil are used for range and tame pasture. A small acreage is used for crops.

This soil has medium potential for crops. It has high potential for peanuts and orchards. Wheat and grain sorghum are the main crops grown. The main concerns of management include a moderate hazard of erosion by wind and water and maintaining soil tilth, soil fertility, and soil moisture. Ample crop residues worked into the surface layer, minimum tillage, and contour tillage are ways to reduce soil losses by erosion. These practices help conserve soil moisture and maintain soil tilth when crops are grown. Utilizing cover crops or grasses and legumes in the crop rotation are additional ways to reduce erosion losses. Crops, tame pasture, or hay will respond favorably to applications of fertilizers.

The potential is high for native grass, tame pasture, and hay. Bermudagrass, lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during periods of drought can help to keep the grass and soil in good condition.

This soil has high potential for most urban uses. Seepage is moderate in areas where the soil is used for sewage lagoons. This can be corrected with proper design or special engineering practices at the time of construction.

This soil is in capability subclass IIIe and in the Deep Sand Savannah range site.

42—Konsil loamy fine sand, 3 to 8 percent slopes. This deep, well drained, gently sloping to sloping soil is on narrow ridgetops and smooth side slopes of uplands. Individual areas are 10 to 160 acres.

Typically, the surface layer is yellowish brown loamy fine sand that extends to a depth of 9 inches. The subsurface layer is light brown loamy fine sand that extends to a depth of 14 inches. The upper part of the subsoil is yellowish red sandy clay loam that extends to a depth of 27 inches. The middle part of the subsoil is reddish yellow sandy clay loam that extends to a depth of 37 inches. The lower part of the subsoil is reddish yellow fine sandy loam that extends to a depth of 62 inches. The underlying material is reddish yellow, weakly cemented sandstone to a depth of 70 inches.

This soil has a medium available water capacity. Permeability is moderate, and surface runoff is slow. This soil can be worked through a wide range of moisture conditions but is subject to soil blowing if it is not protected on the surface.

Included with this soil in mapping are small areas of soils similar to the Konsil soil except that they have a surface layer of loamy fine sand more than 20 inches thick. Also in small areas are soils similar to the Konsil soil except that they have soft sandstone at depths between 40 and 60 inches. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Konsil soil are used for range and tame pasture. Some areas are used for crops.

This soil has medium potential for crops. Wheat is the main crop. The main concerns of management include a moderate hazard of erosion by wind and water and maintaining soil fertility, soil moisture, and tilth. Cover crops help control erosion in row crops. Where small grains or other sown crops are grown, high levels of residue should be maintained as a mulch worked into the surface layer to help prevent blowing and maintain good tilth. The use of fertilizers helps to increase production of crop residues and increases forage production of tame pasture plants.

The potential is medium for tame pasture and hay. Potential is high for native grass. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during periods of drought help to keep the grass and soil in good condition.

This soil has high potential for most urban uses. Seepage is the main limitation for sewage lagoons, and slope is the main limitation for small commercial buildings. Most of these limitations can be overcome through proper design or special engineering practices at the time of construction.

This soil is in capability subclass IVe and in the Deep Sand Savannah range site.

43—Konsil loamy fine sand, 2 to 8 percent slopes, gullied. This deep, well drained, very gently sloping to sloping, gullied soil is on side slopes of uplands. Individual areas are 5 to 80 acres.

Gullies caused by water erosion are 10 to 30 feet in width, 3 to 10 feet in depth, and 100 to 500 feet apart. Most of the original surface layer has been removed by erosion in about 60 percent of the area. In about 20 percent of the mapped area the surface layer has been mixed with the subsoil by tillage. The surface layer between the gullies averages about 5 inches thick.

Typically, the surface layer is light brown loamy fine sand that extends to a depth of about 4 inches. The subsurface layer is pinkish gray loamy fine sand that extends to a depth of 12 inches. The upper part of the subsoil is red sandy clay loam that extends to a depth of about 30 inches. The middle part of the subsoil is yellowish red sandy clay loam that extends to a depth of 46 inches. The lower part of the subsoil is reddish yellow fine sandy loam that extends to a depth of 65 inches. The underlying material is weakly cemented sandstone to a depth of more than 80 inches.

This soil has a medium available water capacity. Permeability is moderate, and surface runoff is moderate to rapid. The root zone is deep and easily penetrated by plant roots. The erosion hazard is severe. Proper conservation practices are needed to prevent further erosion.

Included with this soil in mapping are small areas of Konsil soils that have a fine sandy loam surface texture. In a few intermingled areas, soils similar to the Konsil soil have sandstone at a depth of 40 to 60 inches. These included soils make up 20 percent of the unit, but individual areas are generally less than 5 acres.

This soil is used mostly for range. A few areas are used for tame pasture. This soil is generally not suitable for crops. The main concern in management is protecting the soil from additional erosion and improving soil fertility. Fertilizing tame pasture grasses and legumes for maximum residues helps to reduce soil erosion and maintain fertility. Runoff from higher areas should be diverted and banks of gullies shaped before establishing a permanent cover in most areas.

The potential is low for native grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Renovating and planting grass in the gullied areas can help control erosion. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during prolonged dry periods can help to keep the grass and soil in good condition.

This soil has medium potential for most urban uses. Soil limitations include gullied areas and little or no topsoil over much of the area. This unit requires land shaping and smoothing with extensive cuts and fills. Most community facilities can be designed to overcome these limitations by special engineering practices.

This soil is in capability subclass VIe and in the Eroded Sandy Savannah range site.

44—Lela clay, rarely flooded. This deep, somewhat poorly drained, nearly level soil is on flood plains along the Washita River. It is rarely flooded. Slopes are smooth to slightly concave and are less than 1 percent. Individual areas are 40 to 160 acres.

Typically, the surface layer is dark reddish gray clay that extends to a depth of about 24 inches thick. The subsoil is red clay that extends to a depth of about 42 inches. The underlying material is red clay to a depth of 72 inches or more.

This soil has a high available water capacity. Permeability is very slow, and surface runoff is slow. This soil has fair to poor tilth and can be worked through a very narrow range of moisture conditions. The root zone is deep, but the soil is not easily penetrated by plant roots.

Included with this soil in mapping are intermingled small areas of McLain soils. Also included are a few areas of Asher soils along the outer edges. These included soils make up about 10 percent of the unit, but individual areas generally are less than 5 acres.

This soil is used mainly for crops. Some areas are used for tame pasture.

This soil has medium potential for crops. It is primarily used for alfalfa and wheat. A few areas are used for corn, grain sorghum, and soybeans. Plant growth is reduced by flooding and slow runoff. Maintenance of soil fertility and desirable structure are some of the concerns of soil management. In some areas surface drainage is a problem. Changing tillage depth and tilling at a time when least compaction would occur will help maintain good soil structure and reduce the chances of a tillage pan forming. Simple drainage and proper row direction can help remove surplus water. High soil fertility can be maintained by returning large amounts of crop residue to the soil and applying adequate kinds and amounts of fertilizer on a yearly basis.

The potential is medium for tame pasture and hay. Potential is high for native grass. Bermudagrass and King Ranch or plains bluestem are the main plants used for tame pasture. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods can help keep the grass and soil in good condition.

This soil has low potential for most urban uses. Most of the properties of this soil are unfavorable for building sites because of a high shrink-swell potential and flooding.

This soil is in capability class IIIw and in the Heavy Bottomland range site.

45—Loco silty clay loam, 3 to 8 percent slopes. This shallow, well drained, gently sloping to sloping soil is on side slopes and ridge crests of prairie uplands. Slopes are smooth and convex. Individual areas are 5 to 80 acres.

Typically, the surface layer is dark grayish brown silty clay loam that extends to a depth of 6 inches. The subsoil is light brownish gray silty clay loam that extends to a depth of 17 inches. The underlying material is gray clayey shale to a depth of more than 26 inches.

This soil has a low available water capacity. Permeability is moderate, and surface runoff is rapid. The root zone is shallow, and roots are restricted by interbedded clayey shales and siltstone.

Included with this soil in mapping are areas of Newalla, Renfrow, and Zaneis soils. Also included are intermingled areas of soils similar to the Loco soil except that they are more than 20 inches deep over bedrock. These included soils make up about 18 percent of the unit, but individual areas are generally less than 5 acres.

This soil is generally not suited to crops. Most areas are in range, and some small areas are in tame pasture and hay.

This soil has low potential for growing native grass, tame pasture, and hay. Its potential is limited by the shallow depth over rock, low water holding capacity, and slopes. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Quality of native grasses, tame pasture, and hay can be maintained or improved by proper stocking rates, rotation of grazing, deferred grazing, and protection from fire. This soil is subject to severe erosion if a good grass cover is not maintained to protect it.

This soil has low potential for most urban uses. The shallow depth of the soil limits most uses. For some uses the limitations can be overcome by careful design and installation.

This soil is in capability subclass VIe and in the Shallow Prairie range site.

46—Lucien stony loam, 12 to 30 percent slopes. This shallow, well drained, moderately steep to steep soil is on prairie uplands. The surface is 1 to 15 percent stones and rock fragments more than 3 inches in diameter. This soil occurs on narrow ridge crests. Individual areas are 15 to 90 acres.

Typically, the surface layer is weak, red stony loam that extends to a depth of about 5 inches. The subsoil is red stony loam that extends to a depth of 15 inches. The underlying material is weak, red, fine grained sandstone.

This soil has a low available water capacity. Permeability is moderately rapid, and surface runoff is rapid. Root penetration is restricted by the shallow depth over sandstone bedrock.

Included with this soil in mapping are small areas of Stephenville, Loco, and Grainola soils. Also included are minor areas of soils that are more than 40 inches deep over bedrock. These soils make up about 25 percent of the unit, but individual areas are generally less than 5 acres.

This Lucien soil is not suited to crops, tame pasture, or hay. Most areas are used for range. Stones, shallow depth to rock, and steep slopes are limitations that are very difficult to overcome.

This soil has low potential for producing native grasses for grazing. Potential for tame pasture and hay is low. The stones, shallow soil depth, and steep slopes limit this soil's potential for tame pasture and hay. Management problems include protecting native grasses from overgrazing and burning. Encroachment of brush and weeds is a problem. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods can help keep the grass and soil in good condition.

This soil has low potential for most urban uses. Building sites of these soils are hampered by steep slopes, shallow soil depth, and stones on the surface.

This soil is in capability subclass VIIs and in the Shallow Prairie range site.

47—Lucien-Nash complex, 5 to 12 percent slopes. This complex consists of sloping to strongly sloping, well drained soils on prairie uplands. Areas of these soil are so intermingled that it was not practical to separate them at the scale selected for mapping. The shallow Lucien soils are on ridge crests and upper side slopes. The moderately deep Nash soils are on the mid and lower side slopes. Mapped areas are 10 to 100 acres.

The Lucien soils make up about 70 percent of the units. Typically, the surface layer is reddish brown loam that extends to a depth of about 4 inches. The subsoil is reddish brown very fine sandy loam that extends to a depth of 12 inches. The underlying material is red sandstone interbedded with siltstone and clayey shale to a depth of more than 15 inches.

Lucien soils have a low available water capacity. Permeability is moderately rapid, and surface runoff is medium. The root zone is shallow and restricts root penetration.

The Nash soils make up about 15 percent of the unit. Typically, the surface layer is reddish brown silt loam that extends to a depth of about 10 inches. The upper part of the subsoil is reddish brown silt loam that extends to a depth of 23 inches. The lower part is yellowish red very fine sandy loam that extends to a depth of 28 inches. The underlying material is yellowish red, fine grained sandstone to a depth of more than 32 inches.

Nash soils have a medium to high available water capacity. Permeability is moderate, and surface runoff is medium. The root zone is moderately deep and easily penetrated.

Included in mapping are small areas of Stephenville and Zaneis soils. Also included are minor areas of rock outcrops. These included soils and rock outcrops make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this complex are in native grass and are used for range. A few areas are in tame pasture and hay. These soils are not suited to crops.

This complex has low potential for crops. The shallow depth of the soil, the slopes, and small areas of rock outcrop are limitations that limit crop production.

This complex has medium potential for producing native grasses, tame pasture, and hay. Management problems include protecting native grasses from overgrazing and burning. Encroachment of weeds is a problem on poorly managed areas. The shallow soils and strong slopes limit the potential for tame pasture and hay. Tame pasture is effective for controlling erosion. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Overgrazing or grazing the grass when the soils are too wet will cause excessive runoff. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods can help keep the grasses and soils in good condition.

This complex has low potential for most urban uses. Building sites are hampered by the shallow depth of these soils. The shallow depth over rock limits septic tank absorption fields. This limitation can be overcome by proper design or special engineering practices at the time of construction.

This complex is in capability subclass VIe. The Lucien soil is in the Shallow Prairie range site. The Nash soil part is in the Loamy Prairie range site.

48—McLain silty clay loam, rarely flooded. This deep, moderately well drained, nearly level soil is on flood plains that are rarely flooded. Slopes range from 0 to 1 percent and are usually smooth with some slightly concave areas. Individual areas are 20 to 200 acres.

Typically, the surface layer is dark brown silty clay loam that extends to a depth of 6 inches. The next layer is dark reddish gray silty clay loam that extends to a depth of 15 inches. The upper part of the subsoil is reddish brown silty clay that extends to a depth of 27 inches. The lower part of the subsoil is reddish brown silty clay loam that extends to a depth of 40 inches. The underlying material is reddish brown silty clay loam to a depth of more than 72 inches.

This soil has a high available water capacity. Permeability is slow, and surface runoff is slow. This soil has fair tilth, but small depressional areas may remain wet longer after rains and delay tillage operations.

Included with this soil in mapping are small areas of the Asher and Dale soils. These included soils are on slightly higher areas and make up about 20 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this McLain soil are used for crops. Few areas are used for tame pasture.

This soil has high potential for crops. It is primarily used for alfalfa and wheat. Other crops are soybeans, corn, cotton, and grain sorghum. Surface drainage, flooding, and maintenance of soil structure and fertility are the main concerns of soil management. A simple drainage system with proper row direction can help eliminate surface water. Changing tillage depth and tilling at a time when the least compaction would occur will help maintain good soil structure and reduce the chances of a tillage pan forming. High soil fertility can be maintained by returning large amounts of crop residue to the soil and applying adequate kinds of amounts of fertilizer on a yearly basis.

The potential is high for native grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods can help keep the grass and soil in good condition.

This soil has low potential for most urban uses because of possible flooding and a high shrink-swell potential. Slow permeability is a limitation for septic tank absorption fields. The clayey subsoil and flooding are limitations for trench type landfills. Sewage lagoon disposals and area type landfills have few limitations except for the rare possibility of flooding.

This soil is in capability class I and in the Heavy Bottomland range site.

49—McLain-Urban land complex, rarely flooded. This complex consists of deep, moderately well drained, nearly level McLain soils and areas of Urban land on flood plains that are rarely flooded. Urban land is used for buildings, streets, houses, and roads. Areas of these soils and Urban land are so intermingled that it was not practical to separate them at the scale selected for mapping.

The McLain soils make up about 45 percent of the unit. Typically, the surface layer is dark brown silty clay loam that extends to a depth of about 6 inches. The next layer is dark reddish gray silty clay loam that extends to a depth of 15 inches. The upper part of the subsoil is reddish brown silty clay that extends to a depth of 27 inches. The lower part of the subsoil is reddish brown silty clay loam that extends to a depth of 40 inches. The underlying material is reddish brown silty clay loam to a depth of more than 72 inches.

McLain soils have a high available water capacity. Permeability is slow, and surface runoff is slow. The soil has fair tilth except in some small depressional areas.

In about 30 percent of the area of this map unit, the McLain soils have been modified by excavating, filling, and grading. In excavated and filled areas, the surface layer is a mixture of loamy and clayey material.

Urban land makes up about 20 percent of the unit. It is used for buildings, streets, houses, and roads. Urban land has very rapid surface runoff.

Included in mapping are small areas of Asher, Dale, and Keokuk soils. These included soils make up about 35 percent of the unit.

This complex is used mostly for urban development, picnic areas, playgrounds, houses, roads, and streets. The main concerns of using this complex in urban areas are the flooding hazard and a shrink-swell potential. The McLain soil is well suited to trees, shrubs, flowers, lawn grasses, or garden plants and also for playgrounds and picnic areas. This complex has low potential for camp areas. Flooding is the main concern for this use. This complex has low potential for septic tank absorption fields, dwellings, commercial buildings, roads, and streets because of the flooding, slow permeability, and shrinking and swelling of the soils.

No capability unit or range site has been assigned to this complex.

50—Newalla fine sandy loam, 1 to 3 percent slopes. This deep, moderately well drained, very gently sloping soil occurs on broad to narrow, smooth ridge crests on forested uplands. Individual areas are 20 to 160 acres.

Typically, the surface layer is brown fine sandy loam that extends to a depth of 5 inches. The subsurface layer is light reddish brown fine sandy loam that extends to a depth of 8 inches. The upper part of the subsoil is reddish brown sandy clay loam that extends to a depth of 12 inches. The middle part of the subsoil is reddish brown and red clay that extends to a depth of 38 inches. The lower part of the subsoil is light red sandy clay with common reddish yellow mottles that extends to a depth of 50 inches. The underlying material is reddish yellow, soft sandstone and clayey shale to a depth of more than 65 inches.

This soil has a high available water capacity. Permeability is very slow, and surface runoff is medium to rapid. The root zone is deep, but the clayey subsoil restricts root growth.

Included with this soil in mapping are small areas of Stephenville soils on adjacent side slopes and small areas of soils similar to the Newalla soil except that the subsoil is yellowish brown or brownish yellow. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Most of this Newalla soil is used for tame pasture and hay. Some areas are used for crops or range.

This soil has medium potential for crops. Wheat and grain sorghum are the main crops. Soil management is needed to maintain fertility and soil structure and to control the loss of soil through water or wind erosion. Cropping systems should include high-residue crops so that adequate amounts of crop residue can be returned to the soil. Erosion can be reduced by contour farming with terraces and managing crop residue. Plant cover or residue is needed in fall and spring months to help keep the soil from eroding. Using fertilizer increases plant growth and provides additional crop residue for erosion control. Terracing, contour farming, and using cover crops are especially needed where row crops are grown. Excessive tillage should be avoided.

The potential is medium for native grass, tame pasture, and hay. Bermudagrass, lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing the grass when the soil is too wet will cause surface crusting and excessive runoff. Proper stocking rates, rotation of grazing, timely deferment of grazing, and restricted use during wet periods can help keep the grass and soil in good condition.

This soil has low potential for most urban uses. The clayey subsoil is very slowly permeable, which is the main limitation for septic tank absorption fields. This can be overcome by increasing the size of the absorption area or modifying the field. This soil has a high potential for shrinking and swelling that can cause foundations to crack. Most facilities can be designed to overcome this limitation.

This soil is in capability subclass IIIe and in the Sandy Savannah range site.

51—Newalla fine sandy loam, 3 to 5 percent slopes. This deep, moderately well drained, gently sloping soil occurs on broad to narrow smooth convex side slopes on forested uplands. Individual areas are 5 to 160 acres.

Typically, the surface layer is brown fine sandy loam that extends to a depth of about 4 inches. The subsurface layer is light brown fine sandy loam that extends to a depth of about 8 inches. The upper part of the subsoil is reddish brown clay loam that extends to a depth of 18 inches. The middle subsoil is yellowish red clay that extends to a depth of 36 inches. The lower subsoil is light reddish brown clay with brownish yellow mottles that extends to a depth of 54 inches. The underlying material is soft clayey shale interbedded with sandstone.

This soil has a high available water capacity. Permeability is very slow, and surface runoff is medium to rapid. The root zone is deep, but the clayey subsoil restricts root growth.

Included with this soil in mapping are small areas of Stephenville soils on adjacent side slopes, small areas of similar soils with a yellowish brown or brown subsoil, and small areas of similar soils that are less than 40 inches deep over bedrock. These included soils make up about

15 to 20 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Newalla soil are used for tame pasture and range. A small acreage is used for crops.

This soil has medium potential for crops. Small grain crops are grown. Tilth is maintained by returning high levels of crop residue to the soil. The erosion hazard is moderate if this soil is cultivated. Using terraces, contour farming, minimum tillage, and residue management are ways to help reduce runoff and control erosion. Use of fertilizers helps produce higher yields for most crops.

The potential is medium for native grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, King Ranch bluestem, and plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing the grass when the soil is too wet will cause surface crusting and excessive runoff. Proper stocking rates, rotation of grazing, timely deferment of grazing, and restricted use during wet periods can help keep the grass and soil in good condition.

This soil has low potential for most urban uses. The clayey subsoil is very slowly permeable, which is the main limitation for septic tank absorption fields. This limitation can be overcome by increasing the size of the absorption area or modifying the field. This soil has a high shrink-swell potential that requires special construction for dwellings.

This soil is in capability subclass IVe and in the Sandy Savannah range site.

52—Newalla fine sandy loam, 2 to 5 percent slopes, eroded. This deep, moderately well drained, very gently sloping to gently sloping, eroded soil occurs on broad to narrow, smooth convex side slopes on forested uplands. Erosion has caused shallow gullies and a few deep gullies. About 30 to 75 percent of the original surface layer has been eroded away over most of this unit. The subsoil is exposed on about 25 percent of the surface. Mapped areas are 10 to 80 acres.

Typically, the surface layer is brown fine sandy loam that extends to a depth of about 4 inches. The upper part of the subsoil is yellowish red sandy clay loam that extends to a depth of 12 inches. The middle part of the subsoil is reddish yellow clay that extends to a depth of 23 inches. The lower part of the subsoil is reddish yellow sandy clay with red mottles that extends to a depth of 40 inches. The underlying material is reddish yellow, soft sandstone and clayey shale.

This soil has a high available water capacity. Permeability is very slow, and surface runoff is medium to rapid. The root zone is deep, but the clayey subsoil restricts root growth.

Included with this soil in mapping are small areas of Stephenville soils on adjacent side slopes and small areas of similar soils with a subsoil that is brownish yellow or light yellowish brown, and small areas of similar soils that are less than 40 inches deep over bedrock. These included soils make up about 20 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Newalla soil are used for tame pasture and hay. Some areas are used for range, and a small acreage is used for crops.

This soil has low potential for crops. Its potential is limited by the thin layer over the clayey subsoil. Where this soil is farmed, small grain crops are grown. The main concerns of management are a hazard of erosion and improving soil structure and soil fertility. Additional erosion can be retarded by installing terraces, contour farming, using grasses and legumes in the crop rotation, planting high-residue crops, and using cover crops. Returning ample crop residue to the soil and minimum tillage are ways to improve soil structure and fertility. Using tame pasture grasses is the best way to protect the soil from eroding.

The potential is medium for range grass, tame pasture, and hay. Bermudagrass, lovegrass, King Ranch bluestem, and plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing when the soil is too wet will cause surface crusting and excessive runoff. Proper stocking rates, rotation of grazing, timely deferment of grazing, and restricted use during wet periods help to keep the grass and soil in good condition.

This soil has low potential for most urban uses. A high shrink-swell potential and limited topsoil are limitations, but they can be overcome by good design and careful installation procedures. The clayey subsoil is very slowly permeable, which is the main limitation for septic tank absorption fields. This can be overcome by increasing the size of the absorption area or modifying the field. The lagoon system of disposal would be an alternative.

This soil is in capability subclass IVe and in the Sandy Savannah range site.

53—Norge silt loam, 0 to 1 percent slopes. This deep, well drained, nearly level soil is on broad convex flats on high stream terraces of prairie uplands. Slopes are smooth to slightly convex. Individual areas are 5 to 75 acres.

Typically, the surface layer is brown silt loam that extends to a depth of about 11 inches. The upper part of the subsoil is reddish brown silt loam that extends to a depth of about 17 inches. The middle part is reddish brown silty clay loam that extends to a depth of about 45 inches. The lower part is reddish brown clay loam to a depth of 72 inches or more.

This soil has a high available water capacity. Permeability is moderately slow, and surface runoff is slow. The root zone is deep and easily penetrated by plant roots.

Included with this soil in mapping are small areas of Teller and Vanoss soils and small areas of soils that are similar to the Norge soil except that they have a thicker surface layer and a more clayey subsoil. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Norge soil are used for crops. Some are used for tame pasture, hay, and range.

This soil has high potential for crops. It is used mainly for wheat and grain sorghums. Important management practices on this soil are those that maintain soil tilth and fertility. Returning crop residue to the soil and annually applying fertilizer are important for maintenance of high fertility on cropland.

The potential is high for native grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods help to keep the grass and soil in good condition. Weeping lovegrass and improved bermudagrass respond well to fertilizers.

This soil has medium potential for most urban uses. It has a moderate shrink-swell potential that is the main limitation for dwellings, but this can be overcome by design and careful installation. The clayey subsoil is moderately slowly permeable, which is a limitation for septic tank absorption fields. This can be overcome by increasing the size of the absorption area or modifying the field.

This soil is in capability class I and in the Loamy Prairie range site.

54—Norge silt loam, 1 to 3 percent slopes. This deep, well drained, very gently sloping soil is on broad convex flats on high stream terraces of prairie uplands. Slopes are smooth and convex. Individual areas are 5 to 160 acres.

Typically, the surface layer is dark brown silt loam that extends to a depth of about 10 inches. The upper part of the subsoil is reddish brown silty clay loam that extends to a depth of 45 inches. The lower part of the subsoil is red silty clay loam to a depth of 72 inches or more.

This soil has a high available water capacity. Permeability is moderately slow, and surface runoff is medium. The root zone is deep and easily penetrated by plant roots.

Included with this soil in mapping are intermingled areas of soils similar to the Norge soil except that they have a silty clay subsoil. Also included are a few small areas of Teller soils. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Norge soil are used for crops. Some areas are used for tame pasture and hay, and a small acreage is in range.

This soil has high potential for crops. It is used primarily for wheat and grain sorghum. Controlling water erosion and maintaining desirable soil tilth and fertility are the main concerns of soil management. Water erosion can be controlled by keeping an adequate cover of crop residue on the soil surface. Where this cover is not adequate to control water erosion, terraces are needed. Additional fertilizer should be applied where crop residue is returned to the soil or left on the surface.

The potential is high for native grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing when the soil is too wet will cause surface crusting and excessive runoff. Proper stocking rates, rotation of grazing, deferment of grazing, and restricted use during wet periods can help keep the grass and soil in good condition.

This soil has medium potential for most urban uses. It has a moderate shrink-swell potential that is the main limitation, but this can be overcome by good design and careful installation. The clayey subsoil is moderately slowly permeable, which is a limitation for septic tank absorption fields. This can be overcome by increasing the size of the absorption area or modifying the field.

This soil is in capability subclass IIe and in the Loamy Prairie range site.

55—Oil-wasteland consists of areas where liquid wastes, principally oil and saltwater brine, have accumulated. This unit is in most parts of the county that produce oil and gas. The areas range from about 5 acres to 30 acres in size. Slopes are mostly 0 to 8 percent. Surface runoff is rapid, and erosion is a severe hazard.

Oil-wasteland is unsuitable for farming. Some of it could be reclaimed, but the cost would be high. Diversion of surface drainage from higher areas would be necessary. Rainwater could be impounded on the surface to help leach out soluble salts. A mulch of hay or straw would reduce evaporation and thus help prevent accumulation of salts on the surface.

Very little vegetation grows on these areas. Severe erosion has occurred on some of these soils, leaving little or no topsoil for plant growth. Salt-tolerant pasture plants can be grown if they are seeded in the middle of the rainy season, when the salt accumulations on the surface are reduced. Most areas will require smoothing, grading, and diversion of runoff from adjacent areas. Topsoil from nonaffected areas can then be spread on the surface and vegetation established.

Urban potential of this land is very low. It is very difficult to overcome the high susceptibility to erosion and corrosive effect of the salts within the soils.

This Oil-wasteland is in capability subclass VIIIs. It is not assigned a range site.

56—Port fine sandy loam, overwash, occasionally flooded. This deep, well drained, nearly level soil is on flood plains and is occasionally flooded for brief periods. Slopes are smooth to convex and range from 0 to 1 percent. Individual areas are 5 to 100 acres.

Typically, the surface layer is reddish brown fine sandy loam that extends to a depth of about 14 inches. The next layer is reddish brown silt loam that extends to a depth of 26 inches. The subsoil is dark reddish gray silty clay loam that extends to a depth of 40 inches. The underlying material is reddish brown silt loam and light reddish brown loam to a depth of more than 72 inches.

This soil has a high available water capacity. Permeability is moderate, and surface runoff is slow. This soil has good tilth and can be worked over a wide range of moisture conditions. It has a deep root zone that is easily penetrated.

Included with this soil in mapping are a few small areas of Pulaski and Yahola soils that occur next to the stream channel. These included soils make up about 20 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Port soil are used for crops. Some areas are in tame pasture and hay.

This soil has high potential for crops. It is used mainly for wheat, grain sorghum, and alfalfa. Good tilth can be maintained by returning crop residue to the soil. Diversion terraces help to control runoff from adjacent side slopes, and overflow can be minimized by detention reservoirs upstream.

The potential is high for native grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, King Ranch bluestem, and plains bluestem are the main plants used for tame pasture. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods can help keep the grass and soil in good condition.

The potential for most urban uses is low because of the risk of damaging floods. Upstream flood-control measures, however, have lessened the risk, but flooding is still a possibility.

This soil is in capability subclass IIw and in the Loamy Bottomland range site.

57—Port silt loam, occasionally flooded. This deep, well drained, nearly level soil is on flood plains and is occasionally flooded for brief periods. Slopes are smooth to convex and range from 0 to 1 percent. Individual areas are 5 to 250 acres.

Typically, the surface layer is reddish brown silt loam that extends to a depth of 14 inches. The next layer is dark reddish brown silt loam that extends to a depth of 27 inches. The subsoil is reddish brown silty clay loam that extends to a depth of 48 inches. The underlying material is reddish brown silt loam to a depth of more than 72 inches.

This soil has a high available water capacity. Permeability is moderate, and surface runoff is slow. This soil has good tilth and has a deep root zone that is easily penetrated.

Included with this soil in mapping are small areas of Gracemont, Pulaski, and Yahola soils. The Gracemont soil is in depressional areas. The Pulaski and Yahola soils occur next to the stream channels. Small intermingled areas of Asa soils and similar soils that have mottling in the subsoil are also included. These included soils make up about 30 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Port soil are used for crops. A few areas are used for tame pasture and hay.

This soil has high potential for crops. It is primarily used for alfalfa, wheat, and grain sorghum. Maintenance of soil fertility and desirable tilth are prime concerns of soil management. Changing the tillage depth and tilling at a time when least compaction would occur will help maintain good soil tilth and reduce the chances of a tillage pan forming. High soil fertility can be maintained by returning large amounts of crop residue to the soil and applying adequate kinds and amounts of fertilizer on a yearly basis.

Potential is high for range grass, tame pasture, and hay. Bermudagrass and King Ranch or plains bluestem are the main plants used for tame pasture. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods can help to keep the grass and soil in good condition.

The potential for most urban uses is low because of the flood hazard. Upstream flood control has lessened the risk, but special engineering practices are needed during construction.

This soil is in capability subclass IIw and in the Loamy Bottomland range site.

58—Port and Pulaski soils, frequently flooded. This map unit consists of deep, well drained, nearly level soils on narrow, meandering flood plains. In most years these soils are flooded two or more times, commonly during the spring months. The pattern of these soils is variable from one mapped area to the next. Some areas contain only Port soils, and other areas contain both Port and Pulaski soils. Slopes range from 0 to 1 percent. Individual areas are 10 to 60 acres.

The Port soils make up about 50 percent of most mapped areas. Typically, the surface layer is dark reddish gray silt loam that extends to a depth of about 6 inches. The next layer is reddish brown silt loam that extends to a depth of 23 inches. The subsoil is red silty clay loam that extends to a depth of about 38 inches. The underlying material is red silt loam to a depth of about 60 inches.

Port soils have a high available water capacity. Permeability is moderate, and surface runoff is slow. The root zone is deep and easily penetrated by plant roots.

The Pulaski soils make up about 30 percent of most mapped areas. Typically, the surface layer is light brown fine sandy loam, which extends to a depth of 9 inches. The next layer is reddish yellow fine sandy loam that extends to a depth of 20 inches. The underlying material is reddish yellow fine sandy loam to a depth of about 60 inches.

Pulaski soils have a medium available water capacity. Permeability is moderately rapid, and surface runoff is moderate to slow. The root zone is deep and easily penetrated by plant roots.

Included in mapping are small areas of Yahola and Elandco soils and soils with a sandy clay loam subsoil that are near the stream channel. The Yahola soils are also near the stream channel, and Elandco soils are intermingled with the Port and Pulaski soils. These soils make up about 20 percent of the unit, but individual areas are generally less than 5 acres.

These soils have high potential for grasses and trees. They are used mainly for range and tame pasture. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Considerable acreages are in trees. This unit is not generally suited to crops. The main concern of management is the frequent flooding. These soils produce good-quality hardwoods where trees are thinned, weeded, and selectively harvested. Pecan production is generally dependable under good management practices. Fertilizing and proper grazing of tame pasture plants are desirable practices to help control erosion by flooding. Brush control is needed to obtain high yields.

These soils have very low potential for most urban uses. The frequent flooding of these soils severely limits their urban use. This unit is usually dissected by drainageways and require extensive engineering and flood-control measures to reduce the flooding hazard.

These Port and Pulaski soils are in capability subclass Vw and in the Loamy Bottomland range site.

59—Pulaski fine sandy loam, occasionally flooded. This deep, well drained, nearly level soil is on flood plains and is occasionally flooded for brief periods. Mapped areas are 10 to 125 acres.

Typically, the surface layer is reddish brown fine sandy loam that extends to a depth of about 12 inches. The upper part of the underlying material is yellowish red, stratified fine sandy loam that extends to a depth of 46 inches. The lower part of the underlying material is stratified, reddish yellow fine sandy loam to a depth of more than 65 inches.

This soil has a medium available water capacity. Permeability is moderately rapid, and surface runoff is slow. This soil has good tilth and can be worked over a wide range of moisture conditions. It has a deep root zone that is easily penetrated.

Included with this soil in mapping are a few small areas of Port soils next to the foot slopes and Yahola soils near the larger stream channels. These included soils make up about 20 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Pulaski soil are used for tame pasture or crops. Some areas are used for range.

This soil has high potential for crops. It is used mainly for wheat, alfalfa, and grain sorghums. Good tilth can be maintained by returning crop residue to the soil. Diversion terraces help to control runoff from adjacent side slopes, and overflow can be minimized by detention reservoirs upstream.

Potential is high for native grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods help to keep the grass and soil in good condition.

The potential is low for most urban uses. Flooding is the main limitation for building site development and sanitary facilities. This limitation can be reduced only by major flood-control measures.

This soil is in capability subclass IIw and in the Loamy Bottomland range site.

60—Rayford cobbly loam, 5 to 20 percent slopes. This map unit consists of very shallow to shallow, well drained, sloping to moderately steep soils on side slopes of prairie uplands. Limestone cobbles cover about 25 percent of the surface. Slopes are complex. Individual areas range from 40 to 200 acres.

Typically, the surface layer is dark brown cobbly loam that extends to a depth of about 5 inches. The next layer is dark brown cobbly clay loam that extends to a depth of 12 inches. Hard limestone conglomerate is below a depth of 12 inches.

This soil has a low available water capacity. Permeability is moderate, and surface runoff is rapid. The root zone is shallow, and root growth is restricted by the limestone bedrock.

Included with this soil in mapping are small scattered areas of Grainola soils and another soil with a red, silty clay loam subsoil that is moderately deep. These included soils make up about 10 percent of the unit, but separate areas are generally less than 5 acres.

Most areas of this Rayford soil are used for range. This soil is not suited to tame pasture or crops because of its shallow depth and cobbly surface.

This soil has low potential for native grasses but is best suited to this use. Low to medium forage yields can be obtained with proper management. The quality of native grasses can be improved by controlling brush, proper stocking, controlling grazing, and preventing fires.

The potential for crops and tame pasture is low. Shallow soil depth and coarse fragments on the surface are limitations that are difficult to overcome.

Figure 8.—Stubble mulch helps reduce runoff and erosion on Renfrow silt loam, 1 to 3 percent slopes.

The potential for most urban uses is low. Shallow depth over bedrock, surface rockiness, and slope are limitations that are difficult and expensive to overcome.

This soil is in capability subclass VIIs and in the Shallow Prairie range site.

61—Renfrow silt loam, 1 to 3 percent slopes. This deep, well drained, very gently sloping soil is on broad, smooth side slopes of prairie uplands. Slopes are smooth and convex. Individual areas are 5 to 160 acres.

Typically, the surface layer is dark brown silt loam that extends to a depth of about 8 inches. The upper part of the subsoil is reddish brown silty clay loam that extends to a depth of 13 inches. The next layer is reddish brown clay that extends to a depth of 26 inches. The next layer is yellowish red clay that extends to a depth of 40 inches. The lower part of the subsoil is red clay that extends to a depth of 61 inches. The underlying material is red clayey shale to a depth of more than 64 inches.

This soil has a high available water capacity. Permeability is very slow, and surface runoff is medium. This soil has moderate tilth. The root zone is deep, but the clayey subsoil restricts root growth.

Included with this soil in mapping are small areas of Bethany and Zaneis soils. These included soils make up about 20 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Renfrow soil are used for crops or tame pasture. Some areas are used for range.

This soil has medium potential for crops. Wheat and grain sorghum are the main crops. The erosion hazard is moderate if this soil is cultivated. Terraces, minimum tillage, growing high-residue crops, and using cover crops are among the practices that can reduce runoff and erosion on this soil (fig. 8).

The potential is medium for native grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hayland are effective for controlling erosion. Overgrazing or grazing the grasses when the soil is too wet will cause surface crusting and excessive runoff. Proper stocking rates, rotation of grazing, timely deferment of grazing, and restricted use during wet periods can help keep the grass and soil in good condition.

This soil has medium potential for most urban uses. A high shrink-swell potential is the main limitation, but this can be overcome by good design and careful installation. The very slowly permeable clayey subsoil is a limitation for septic tank absorption fields but can be overcome by increasing the size of the absorption area or modifying the field.

This soil is in capability subclass IIIe and in the Claypan Prairie range site.

62—Renfrow silt loam, 3 to 5 percent slopes. This deep, well drained, gently sloping soil is on side slopes of prairie uplands. Slopes are smooth and convex. Individual areas are 5 to 80 acres.

Typically, the surface layer is dark brown silt loam about 11 inches thick. The upper part of the subsoil is reddish brown silty clay loam that extends to a depth of 16 inches. The middle part is reddish brown silty clay that extends to a depth of 30 inches. The lower part of the subsoil is red silty clay that extends to a depth of 65 inches. The underlying material is red clayey shale to a depth of more than 72 inches.

This soil has a high available water capacity. Permeability is very slow, and surface runoff is medium. This soil has moderate tilth. The root zone is deep, but the clayey subsoil restricts root growth.

Included with this soil in mapping are small areas of soils similar to the Renfrow soil except that they have clayey shale at depths of 40 to 60 inches. Also included are minor areas of Grainola and Zaneis soils. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Renfrow soil are used for tame pasture or range. Some areas are used for crops.

This soil has medium potential for crops. Most cropland is used primarily for small grain crops such as wheat or oats. Row crops are generally not grown on this soil. The erosion hazard is moderate if this soil is cultivated. The main concerns of soil management are protecting the soil from erosion and maintaining soil tilth and fertility. If clean-tilled crops are grown, terracing, contour farming, returning high levels of plant residues to the soil, and minimum tillage help to control excessive erosion. Most crops respond to applications of fertilizer, and this produces additional crop residues for soil protection.

The potential is medium for native grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing the grass when the soil is too wet will cause surface crusting and excessive runoff. Proper stocking rates, rotation of grazing, timely deferment of grazing, and restricted use during wet periods can help keep the grass and soil in good condition.

This soil has medium potential for most urban uses. A high shrink-swell potential and the slope are limitations, but they can be overcome by good design and careful installation. The very slowly permeable clayey subsoil is a limitation for septic tank absorption fields, but this can be overcome by increasing the size of the absorption area or modifying the field.

This soil is in capability subclass IVe and is in the Claypan Prairie range site.

63—Renfrow silt loam, 2 to 5 percent slopes, eroded. This deep, well drained, very gently sloping to gently sloping, eroded soil occurs on smooth and convex side slopes on prairie uplands. Part of the original surface layer has been removed by erosion in about 80 percent of the area. In about 20 percent of the area the surface layer and upper part of the subsoil have been mixed by tillage. Rills and some shallow gullies are present in some areas. Mapped areas are 5 to 160 acres.

Typically, the surface layer is a reddish brown silt loam that extends to a depth of 7 inches. The upper part of the subsoil is red clay that extends to a depth of about 40 inches. The lower part of the subsoil is light red clay to a depth of more than 63 inches.

This soil has a high available water capacity. Permeability is very slow, and surface runoff is medium to rapid. This soil has moderate tilth. The root zone is deep, but the clayey subsoil restricts root growth.

Included with this soil in mapping are small areas of Bethany, Grainola, and Zaneis soil. Also included are small intermingled areas of soils high in sodium content. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Renfrow soil are used for tame pasture, hay, or range. Some areas are used for crops.

This soil has low potential for crops. Its potential is limited by the thin surface layer over the clayey subsoil. Wheat is the main crop. Under good management, medium yields can be obtained. The main limitation for crops is the severe erosion hazard. Tilth can be improved by returning crop residue to the soil. Minimum tillage, terraces, using cover and soil-improving crops, and including grasses and legumes in the cropping system are practices that help reduce runoff and control erosion. Applying adequate amounts of fertilizer also helps to provide additional plant residues.

The potential is medium for tame pasture, hay and native grass. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing when the soil is too wet will cause surface compaction and excessive runoff. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods can help keep the grass and soil in good condition.

This soil has low potential for most urban uses. A high shrink-swell potential, very slow permeability, and the thin surface layer are limitations for most urban uses. Careful planning and special engineering designs are needed to overcome these limitations.

This soil is in capability subclass IVe and in the Claypan Prairie range site.

64—Renfrow silt loam, 2 to 5 percent slopes, gullied. This deep, well drained, very gently sloping to gently sloping, gullied soil is on smooth to convex side slopes of prairie uplands. Gullies caused by water erosion are 15 to 60 feet in width, 1 to 5 feet in depth, and 100 to 500 feet apart. Most of the original surface layer has been removed by erosion in about 50 percent of the area. In some areas the surface layer has been mixed with the subsoil by tillage. Gullies make up about 10 percent of the area. Shale is exposed in some of the gullies. Mapped areas are 5 to 50 acres.

Typically, the surface layer is reddish brown silt loam that extends to a depth of about 5 inches. The upper part of the subsoil is reddish brown clay that extends to a depth of about 16 inches. The middle part is red clay that extends to a depth of about 37 inches. The lower part of the subsoil is light red clay to a depth of 62 inches.

This soil has a high available water capacity. Permeability is very slow, and surface runoff is rapid. This soil has moderate tilth. The root zone is deep, but the clayey subsoil restricts root growth.

Included in mapping are small areas of Bethany and Zaneis soils and soils similar to the Renfrow soil except that they are less than 60 inches deep over bedrock. Also included are small intermingled areas of soils high in sodium content. These included soils make up about 20 percent of the unit, but individual areas are generally less than 5 acres.

Nearly all areas of this Renfrow soil are used for tame pasture or range. This soil is generally no longer suitable for crops.

The potential is low for tame pasture and range. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. The main concern in management is protecting the soil from accelerated erosion and improving soil fertility and structure. Fertilizing tame pasture and planting legumes for maximum residues help to reduce soil erosion. Runoff from high areas should be diverted and banks of gullies shaped before establishing a permanent cover in most areas. Gullies should be shaped and sodded or planted to grass to minimize soil loss and check siltation.

This soil has low potential for most urban uses. Soil limitations include the gullied areas, the very slow permeability, a high shrink-swell potential in the subsoil, and little or no topsoil over much of the area. Careful planning and special engineering designs are needed to overcome these limitations.

This soil is in capability subclass VIe and in the Eroded Clay range site.

65—Renfrow-Urban land complex, 1 to 5 percent slopes. This complex consists of deep, well drained, very gently sloping to gently sloping Renfrow soils and areas of Urban land on prairie uplands. Urban land is used for buildings, streets, houses, and roads. Areas of these soils and Urban land are so intermingled that it was not practical to separate them at the scale selected for mapping.

The Renfrow soils make up about 40 percent of the units. Typically, the surface layer is dark brown silt loam that extends to a depth of about 8 inches. The upper part of the subsoil is reddish brown silty clay loam that extends to a depth of 13 inches. The next layer is reddish brown clay that extends to a depth of 26 inches. The next layer is yellowish red clay that extends to a depth of 40 inches. The lower part of the subsoil is red clay to a depth of 65 inches.

The Renfrow soil has a high available water capacity. Permeability is very slow, and surface runoff is medium. This soil has moderate tilth. The root zone is deep, but the clayey subsoil restricts root growth.

In about 30 percent of the area, the Renfrow soils have been modified by excavating, filling, and grading. In excavated areas, the surface layer is clayey. The fill material is usually loamy material that has been hauled from other areas.

Urban land makes up about 30 percent of the unit area. It is used for buildings, streets, houses, and roads. Urban land has very rapid surface runoff.

Included in mapping are small areas of Grainola and Zaneis soils. These included soils make up about 30 percent of the unit.

This complex is used mostly for urban development, including industrial sites.

The main concerns of management of this complex in urban areas are the very slow permeability, a high shrink-swell potential, the slopes, and the clayey texture of the subsoil. The Renfrow soils are well suited to lawn grasses, flowers, most shrubs, and garden plants. This complex has moderate limitations for picnic areas and severe limitations for paths and trails in recreational areas. This complex has moderate limitations for sewage lagoons, camp areas, and playgrounds mainly because of slope and very slow permeability. This complex has severe limitations for dwellings, septic tank absorption fields, commercial buildings, and roads or streets because of the very slow permeability and high shrink-swell potential. The clayey texture and alkaline subsoil cause high corrosivity on uncoated steel.

No capability unit or range site has been assigned to this complex.

66—Stephenville fine sandy loam, 1 to 3 percent slopes. This moderately deep, well drained, very gently sloping soil is on ridgetops and side slopes of forested uplands. Slopes are smooth and convex. Individual areas range from 10 to 100 acres in size.

Typically, the surface layer is brown fine sandy loam that extends to a depth of 8 inches. The subsurface layer is light brown fine sandy loam that extends to a depth of 11 inches. The subsoil is reddish brown and red sandy clay loam that extends to a depth of 34 inches. The underlying material is a red sandstone to a depth below 34 inches.

This soil has a medium available water capacity. Permeability is moderate, and surface runoff is medium. The root zone is moderately deep and easily penetrated by plant roots.

Included with this soil in mapping are small areas of soils similar to the Stephenville soil with brownish yellow colors in the subsoil, and minor areas of Newalla soils. Also included are soils similar to Stephenville soil except that they are more than 40 inches deep over bedrock, and they occur on foot slopes near drainageways. These included soils make up about 15 to 25 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Stephenville soil are used for tame pasture, hay, or range. Some areas are used for crops.

This soil has medium potential for crops. Its potential is limited by the size of the areas and the quality of adjacent soils. Small grain crops are the main crops. Good tilth is easily maintained by returning crop residue to the soil. Erosion is a moderate hazard if cultivated crops are grown. Minimum tillage, terracing, contour farming, and using cover crops in the cropping system are practices that help reduce runoff and control erosion.

The potential is medium for tame pasture, hay, or range. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture, hay, or range is effective for controlling erosion. Overgrazing or grazing when the soil is too wet will cause excessive runoff. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods help to keep the grass and soil in good condition.

This soil has medium potential for most urban uses. The depth to bedrock is a limitation for septic tank absorption fields, but this can be overcome by modifying the field or increasing the size of the absorption area and by good design and careful installation.

This soil is in capability subclass IIe and in the Sandy Savannah range site.

67—Stephenville fine sandy loam, 3 to 5 percent slopes. This moderately deep, well drained, gently sloping soil is on side slopes of forested uplands. Individual areas of this unit are irregular in shape and range from 20 to 400 acres.

Typically, the surface layer is brown fine sandy loam that extends to a depth of 5 inches. The subsurface layer is brown fine sandy loam that extends to a depth of 9 inches. The subsoil is red sandy clay loam that extends to a depth of 35 inches. The underlying material is light red, weakly cemented sandstone to a depth below 35 inches.

This soil has a medium available water capacity. Permeability is moderate, and surface runoff is medium. The root zone is moderately deep and easily penetrated by plant roots.

Included with this soil in mapping are minor areas of Newalla soils. On foot slopes near drainageways are soils similar to the Stephenville soil except that they are more than 40 inches deep over bedrock or they have brownish yellow colors in the subsoil. These included soils make up about 25 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Stephenville soil are used for range, tame pasture, and hay. Few areas are used for crops.

This soil has medium potential for crop production, but it is not often used for crops because of the size of the areas and the irregular shape and slope of adjacent soils. Wheat is the main crop. Good tilth is maintained by returning crop residue to the soil. Erosion is a moderate hazard if cultivated crops are grown. Minimum tillage, terraces, using cover crops, and including grasses and legumes in the cropping system are practices that can help reduce runoff and control erosion.

The potential is medium for range, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing when the soil is too wet will cause excessive runoff. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods can help keep the grass and soil in good condition.

This soil has medium potential for most urban uses. The depth to bedrock is the main limitation for septic tank absorption fields and sewage lagoons. This limitation can be overcome by increasing the size of the absorption area or modifying the field and by good design and careful installation.

This soil is in capability subclass IIIe and in the Sandy Savannah range site.

68—Stephenville fine sandy loam, 2 to 5 percent slopes, eroded. This moderately deep, well drained, very gently sloping to gently sloping, eroded soil is on narrow ridgetops and side slopes of forested uplands. The surface layer has been thinned by erosion. The reddish subsoil has been exposed by plowing on about 25 to 50 percent of the area. On an additional 50 percent of the area, more than half of the original surface layer has been removed by erosion. Gullies are present in some areas. Mapped areas are 10 to 100 acres.

Typically, the surface layer is dark yellowish brown fine sandy loam that extends to a depth of 6 inches. The subsoil is red sandy clay loam that extends to a depth of 33 inches. The underlying material is light red, weakly cemented sandstone.

This soil has a medium available water capacity. Permeability is moderate, and surface runoff is medium to rapid. This soil has fair tilth and can be tilled through a wide range of moisture conditions. The erosion hazard is severe where the soil is clean tilled.

Included with this soil in mapping are small areas of soils similar to the Stephenville soil except that they have a yellowish brown subsoil and minor areas of Newalla soils that occur on the convex shoulders. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Most of the acreage of this Stephenville soil is used for range, tame pasture, and hay. A few areas are used for crops.

This soil has low potential for crops. It is limited by the thin surface layer and slopes. Where farmed, it is primarily used for growing small grains. The main concerns of management are a hazard of erosion and improving soil structure and soil fertility. Additional erosion can be retarded by installing terraces, contour farming, using grasses and legumes in the crop rotation, planting high-residue crops, and using cover crops. Returning ample crop residue to the soil and minimum tillage are ways to improve soil structure and fertility. Using tame pasture grasses is the best way to protect the soil from eroding.

The potential is medium for native grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing the grass when the soil is too wet will cause surface crusting and excessive runoff. Proper stocking rates, rotation, timely deferment of grazing, and restricted use during wet periods can help keep the grass and soil in good condition.

This soil has medium potential for most urban uses. The depth to bedrock is the main limitation for septic tank absorption fields and sewage lagoons. This can be overcome by increasing the size of the absorption area or modifying the field and by good design and careful installation.

This soil is in capability subclass IIIe and in the Sandy Savannah range site.

69—Stephenville-Darnell complex, 5 to 20 percent slopes. This complex consists of sloping to moderately steep, moderately deep, well drained Stephenville soils and shallow, well drained to somewhat excessively drained Darnell soils on forested uplands. The Stephenville soils are on side slopes and the Darnell soils are on ridge crests and upper side slopes. Areas of these soils are so intermingled that it was not practical to separate them at the scale selected for mapping. Mapped areas are 20 to 400 acres.

The Stephenville soils make up about 49 percent of the unit. Typically, the surface layer is grayish brown and light grayish brown stony fine sandy loam and fine sandy loam that extends to a depth of about 6 inches. The subsoil is reddish brown sandy clay loam that extends to a depth of about 24 inches. The underlying material is red, weakly cemented sandstone to a depth of more than 30 inches.

Stephenville soils have a medium available water capacity. Permeability is moderate, and surface runoff is medium to rapid. Root penetration is moderately deep. The stony surface restricts the use of farm machinery.

The Darnell soils make up about 20 percent of the unit. Typically, the surface layer is brown fine sandy loam that extends to a depth of about 4 inches. The subsoil is very pale brown fine sandy loam that extends to a depth of about 10 inches. The underlying material is red, weakly cemented sandstone to a depth of more than 15 inches.

Darnell soils have a low available water capacity. Permeability is moderately rapid, and surface runoff is medium to rapid. The root zone is shallow and restricts root penetration.

Included with this complex in mapping are small areas of Newalla soils and soils similar to the Darnell soil except that they have an argillic horizon. A few small areas of rock outcrop are in some mapped areas. These included soils and rock outcrop make up about 31 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this complex are used for range. This complex is not suited to crops, tame pasture, or hay because of the slopes and stones on the surface. The stony surface and moderately steep slopes are limitations that are very difficult to overcome.

This complex has medium potential for native grasses. Management problems include protecting native grasses from overgrazing and burning. Encroachment of brush and weeds is a problem on poorly managed areas. Overgrazing or grazing when the soils are too wet will cause excessive runoff. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods help to keep the grass and soils in good condition.

The potential is low for tame pasture or hay. The stones and moderately steep slopes are limitations that are very difficult to overcome.

Figure 9.—Area of Stephenville and Newalla soils, 2 to 8 percent slopes, gullied.

This complex has low potential for most urban uses. Urban uses of these soils are hampered by stony surface layers, shallow depth of soils, and moderately steep slopes.

This complex is in capability subclass VIIs. The Stephenville soil is in the Sandy Savannah range site. The Darnell soil is in the Shallow Savannah range site.

70—Stephenville and Newalla soils, 2 to 8 percent slopes, gullied. This map unit consists of very gently sloping to sloping, moderately deep, well drained Stephenville soils and deep, moderately well drained Newalla soils on forested uplands. These gullied soils are on side slopes. The pattern of these soils is variable from one mapped area to the next. Some areas contain only Stephenville soil, and other areas contain both Stephenville and Newalla soils. Gullies caused by water erosion are 2 to 20 feet in width, 1 to 6 feet in depth, and 100 to 300 feet apart. Most of the original surface layer has been removed by erosion in about 60 percent of the area. In some areas, the surface layer has been mixed with the subsoil by tillage. Gullies make up about 10 percent of the area. Sandstone or shale is exposed in many of the gullies (fig. 9). Mapped areas are 5 to 160 acres.

The Stephenville soils make up about 40 percent of most mapped areas. Typically, the surface layer is brown fine sandy loam that extends to a depth of about 5 inches. The subsoil is reddish brown and yellowish red sandy clay loam that extends to a depth of 36 inches. This is underlain by reddish and grayish sandstone.

Stephenville soils have a medium available water capacity. Permeability is moderate, and surface runoff is medium to rapid. The root zone is moderately deep and easily penetrated by plant roots.

The Newalla soils make up about 25 percent of most mapped areas. Typically, the surface layer is dark brown fine sandy loam that extends to a depth of about 4 inches. The upper part of the subsoil is reddish brown clay that extends to a depth of 24 inches. The middle part of the subsoil is light reddish brown clay that extends to a depth of 36 inches. The lower part of the subsoil is yellowish red sandy clay that extends to a depth of 42 inches. The underlying material is interbedded, reddish brown shale and yellowish red sandstone.

Newalla soils have a high available water capacity. Permeability is very slow, and surface runoff is medium to rapid. The root zone is deep, but the clayey subsoil restricts root growth.

Included in mapping are areas of soils similar to the Stephenville soil except that they are more than 40 inches deep over bedrock and soils that are less than 20 inches deep over bedrock. These included soils make up about 25 percent of the unit, but individual areas are generally less than 5 acres.

Nearly all areas of this complex are used for tame pasture or range. These soils are generally no longer suitable for crops.

These soils have low potential for grasses. The main concern in management is protecting the soils from accelerated erosion and improving soil fertility and structure. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Fertilizing tame pasture plants and legumes for maximum residues helps to reduce soil erosion. Runoff from higher areas should be diverted and banks of gullies shaped before establishing a permanent cover in most areas. Gullies should be shaped and sodded or planted to grass to minimize soil loss and check siltation.

These soils have low potential for most urban uses. Soil limitations include the gullied areas, the very slow permeability, a high shrink-swell potential in the subsoil, and little or no topsoil over much of the area. Careful planning and special engineering designs are needed to overcome these limitations.

These soils are in capability subclass VIe and in the Eroded Sandy Savannah range site.

71—Teller fine sandy loam, 2 to 5 percent slopes, eroded. This deep, well drained, very gently sloping to gently sloping, eroded soil is on side slopes of high stream terraces of prairie uplands. The surface layer has been thinned by erosion. The reddish brown subsoil has been exposed by tillage on about 25 to 50 percent of the area. On an additional 50 percent of the area, more than half of the original surface layer has been removed by erosion. Gullies are present in some areas. Slopes are convex and parallel the drainageways. Individual areas are 10 to 100 acres.

Typically, the surface layer is brown fine sandy loam that extends to a depth of about 5 inches. The upper part of the subsoil is reddish brown sandy clay loam that extends to a depth of 20 inches. The middle part is red sandy clay loam that extends to a depth of 50 inches. The lower part of the subsoil is reddish yellow fine sandy loam that extends to a depth of 64 inches.

This soil has a high available water capacity. Permeability is moderate, and surface runoff is medium. This soil has good tilth and can be worked over a wide range of moisture conditions. Root penetration is deep.

Included with this soil in mapping are minor areas of Konawa soils. These inclusions make up about 10 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Teller soil are used for tame pasture and hay. Some areas are used for range and a small acreage is used for crops.

This soil has medium potential for crops. The main limitation for crops is the severe erosion hazard due to the slope. Using cover crops, returning maximum amounts of crop residue to the soil, terracing, and contour farming help reduce runoff and erosion. Applying adequate amounts of fertilizer also helps to provide additional plant residues. Growing cover crops helps control wind erosion during the winter and early in spring.

The potential is medium for range, tame pasture, and hay, and this soil is best suited to these uses. This soil is suited to bermudagrass, weeping lovegrass, and other adapted grasses and legumes for hay and pasture. Native grass can be produced in moderate amounts. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing when the soil is too wet will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, rotation grazing, timely deferment of grazing, and restricted use during prolonged wet periods help to keep the grass cover and soil in good condition.

This soil has medium potential for most urban uses. Slope is a limitation for sewage lagoons and commercial buildings. Seepage is the main limitation for sewage lagoons and trench type sanitary landfills. Septic systems with large absorption fields can be substituted for sewage lagoons. This soil has few limitations for dwellings.

This soil is in capability subclass IIIe and in the Loamy Prairie range site.

72—Teller fine sandy loam, 5 to 8 percent slopes, eroded. This deep, well drained, sloping, eroded soil is on narrow ridgetops and side slopes of high stream terraces of prairie uplands. The surface layer has been thinned by erosion. The reddish subsoil has been exposed by plowing on about 25 to 50 percent of the area. On an additional 50 percent of the area, more than half of the original surface layer has been removed by erosion. Gullies are present in some areas. Mapped areas are 10 to 75 acres.

Typically, the surface layer is reddish brown fine sandy loam that extends to a depth of about 8 inches. The upper part of the subsoil is red sandy clay loam that extends to a depth of 32 inches. The lower part of the subsoil is red fine sandy loam to a depth of about 60 inches.

This soil has a high available water capacity, and the permeability is moderate. It is low in natural fertility and organic matter content. Surface runoff is medium. This soil has good tilth and can be tilled through a wide range of moisture conditions. The erosion hazard is severe where the soil is clean tilled. Root penetration is deep.

Included with this soil in mapping are small areas of soils similar to the Teller soil except that they have a yellowish brown subsoil. These included soils make up about 10 percent of the unit, but individual areas are generally less than 5 acres.

Most of the acreage of this Teller soil is used for tame pasture and hay. Some areas are used for crops, and a small acreage is used for range.

This soil has low potential for crops. The main limitation for crops is the severe erosion hazard due to the slope. Using cover crops, returning maximum amounts of crop residue to the soil, and contour farming help reduce runoff and erosion. Applying adequate amounts of fertilizer helps to provide additional plant residues. Growing cover crops helps control wind erosion during the winter and early in spring.

The potential is medium for range, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem grass are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing the pasture when the soil is too wet will cause surface compaction and excessive runoff. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods can help keep the grass and soil in good condition.

This soil has high potential for most urban uses. Seepage is the main limitation for sewage lagoons or trench type sanitary landfills, and slope is the main limitation for small commercial buildings. Most of these limitations can be overcome through proper design or special engineering practices at the time of construction.

This soil is in capability subclass IVe and in the Loamy Prairie range site.

73—Teller fine sandy loam, 2 to 8 percent slopes, gullied. This deep, well drained, very gently sloping to sloping, gullied soil is on side slopes of high stream terraces of prairie uplands.

Gullies caused by water erosion are 10 to 40 feet in width, and 3 to 20 feet in depth, and 20 to 300 feet apart. Between gullies, the surface layer has been removed by erosion in about 10 percent of the area. In about 40 percent of the area, the surface layer has been mixed with the upper part of the subsoil by tillage. In these areas the surface layer is fine sandy loam, loam, or sandy clay loam. The surface layer between gullies averages about 5 inches thick. Gullies make up about 5 to 10 percent of the area. Mapped areas are 5 to 45 acres.

Typically, the surface layer is dark brown fine sandy loam that extends to a depth of about 8 inches. The upper part of the subsoil is brown fine sandy loam that extends to a depth of about 15 inches. The middle part of the subsoil is yellowish red and reddish yellow sandy clay loam that extends to a depth of about 38 inches. The lower part of the subsoil is yellowish red fine sandy loam that extends to a depth of about 52 inches. The underlying material is yellowish red fine sandy loam to a depth of more than 66 inches.

This soil has a high available water capacity. Permeability is moderate, and surface runoff is medium to rapid. Root development is unrestricted to a depth of more than 60 inches.

Included with this soil in mapping are soils that have a loam surface texture. These included soils make up 20 percent of the unit.

This Teller soil is used mostly for range. A few areas are used for tame pasture or hay. This soil is generally not suitable for crops.

The potential is low for range, tame pasture, and hay. Tame pasture and hay are effective for controlling erosion. The main concern in management is protecting the soil from additional erosion and improving soil fertility. Fertilizing tame pasture and legumes for maximum residues helps to reduce soil erosion and maintain fertility. Runoff from higher areas should be diverted and banks of gullies shaped before establishing a permanent cover in most areas. Overgrazing or grazing when the soil is too wet will cause excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil has low potential for most building sites. Soil limitations include the gullied areas and little or no topsoil over much of the area. Most community facilities can be designed to overcome these problems by special engineering practices.

This soil is in capability subclass VIe and in the Eroded Prairie range site.

74—Teller loam, 0 to 1 percent slopes. This deep, well drained, nearly level soil is on broad flats of high stream terraces of prairie uplands. Slopes are smooth and slightly convex. Individual areas range from 10 to more than 300 acres.

Typically, the surface layer is dark brown loam that extends to a depth of about 12 inches. The upper part of the subsoil is dark brown loam that extends to a depth of 18 inches. The middle part is yellowish red clay loam that extends to a depth of 40 inches. The lower part of the subsoil is yellowish red fine sandy loam that extends to a depth of 60 inches. The underlying material is reddish yellow fine sandy loam to a depth of about 75 inches or more.

This soil has a high available water capacity. Permeability is moderate, and surface runoff is slow. This soil has good tilth and can be worked over a wide range of moisture conditions. The root zone is deep and easily penetrated by plant roots.

Included with this soil in mapping are small areas of Vanoss and Norge soils. These included soils make up 5 to 10 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Teller soil are used for crops. Some areas are used for tame pasture and hay.

This soil has high potential for crops. It is used mainly for wheat, alfalfa, and grain sorghums. Important management practices on this soil are those that maintain soil structure and fertility. Returning crop residue to the soil and applying fertilizer are important for maintenance of high fertility on cropland. Timely tillage under proper moisture conditions helps maintain good soil tilth.

The potential is high for range, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods help to keep the grass and soil in good condition.

This soil has high potential for most urban uses. Seepage is the main limitation for sewage lagoons, but a septic system with a large absorption field can be substituted for sewage disposal. There are few limitations for other building development uses.

This soil is in capability class I and in the Loamy Prairie range site.

75—Teller loam, 1 to 3 percent slopes. This deep, well drained, very gently sloping soil is on broad flats and side slopes of high stream terraces of prairie uplands. Slopes are smooth and convex. Individual areas are 10 to 40 acres.

Typically, the surface layer is dark brown loam that extends to a depth of about 12 inches. The subsoil is reddish brown sandy clay loam that extends to a depth of 45 inches. The lower part of the subsoil is yellowish red sandy clay loam that extends to a depth of 56 inches. The underlying material is red fine sandy loam to a depth of 66 inches.

This soil has a high available water capacity. Permeability is moderate, and surface runoff is medium. This soil has good tilth and can be worked over a wide range of moisture conditions. The root zone is deep and easily penetrated by plant roots.

Included with this soil in mapping are minor areas of soils similar to the Teller soils except that they have a thicker surface layer. Also included are other similar soils that have a brown subsoil. These included soils make up about 5 percent of the unit, but individual areas are generally less than 5 acres.

Most of this Teller soil is used for crops. It is also used for tame pasture. A small acreage is used for range.

This soil has high potential for crops. It is used mainly for wheat and grain sorghum. Controlling water erosion and maintaining desirable soil structure and fertility are the main concerns of soil management. Water erosion can be controlled by keeping an adequate cover of crop residue on the soil surface. Where this cover is not adequate to control water erosion, terraces are needed. Timely tillage under proper moisture conditions helps maintain good tilth. Additional fertilizer should be applied where crop residue is returned to the soil or left on the surface.

The potential is high for range, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing when the soil is too wet will cause excessive runoff. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods can help keep the grass and soil in good condition.

This soil has high potential for most urban uses. Seepage is a limitation for sewage lagoons and trench type sanitary landfills. Septic systems with a large absorption field can be substituted for lagoons for sewage disposal. This soil presents few limitations for other building development uses.

This soil is in capability subclass IIe and in the Loamy Prairie range site.

76—Teller loam, 3 to 5 percent slopes. This deep, well drained, gently sloping soil is on side slopes of high stream terraces of prairie uplands. Slopes are smooth and parallel to the drainageways. Individual areas are 10 to 40 acres.

Typically, the surface layer is dark brown loam that extends to a depth of 8 inches. The upper part of the subsoil is reddish brown loam that extends to a depth of 16 inches. The middle part of the subsoil is reddish brown sandy clay loam that extends to a depth of 40 inches. The lower part of the subsoil is yellowish red sandy clay loam that extends to a depth of 52 inches. The underlying material is yellowish red fine sandy loam to a depth of 70 inches or more.

This soil has a high available water capacity. Permeability is moderate, and surface runoff is medium. This soil has good tilth and can be worked over a wide range of moisture conditions. The root zone is deep and easily penetrated by plant roots.

Included with this soil in mapping are small areas of Konawa soils. These inclusions make up 5 to 10 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Teller soil are used for tame pasture and hay. Some areas are used for range, and a small acreage is used for crops.

This soil is somewhat limited for crop production due to the irregular shape and size of the areas. It has medium potential for crops. Tame pasture crops that require less frequent use of machinery have more potential. Where crops are grown, good tilth can be maintained by returning crop residue to the soil. Water erosion on cropland can be controlled by keeping an adequate cover of crop residue on the surface. Where this is not adequate to control water erosion, terraces and farming on the contour are needed for good erosion control.

The potential is high for range, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing when the soil is too wet will cause excessive runoff. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods can help keep the grass and soil in good condition.

This soil has high potential for most urban uses. Seepage is the main limitation for sewage lagoons and trench type sanitary landfills. Septic systems with a large absorption field can be substituted for sewage disposal. The soil has few limitations for other building development uses.

This soil is in capability subclass IIIe and in the Loamy Prairie range site.

78—Teller-Urban land complex, 0 to 5 percent slopes. This complex consists of deep, well drained, nearly level to gently sloping Teller soils and areas of Urban land on broad flats and side slopes of high stream terraces of prairie uplands. Urban land is used for buildings, roads, houses, and streets. Areas of these soils and Urban land are so intermingled that it was not practical to separate them at the scale selected for mapping.

The Teller soils make up about 50 percent of the unit. Typically, the surface layer is dark brown loam that extends to a depth of about 8 inches. The upper part of the subsoil is reddish brown loam that extends to a depth of 16 inches. The middle part of the subsoil is yellowish red sandy clay loam that extends to a depth of 40 inches. The lower part of the subsoil is yellowish red fine sandy loam that extends to a depth of 52 inches. The underlying material is reddish yellow fine sandy loam that extends to a depth of about 70 inches or more.

Teller soils have a high available water capacity. Permeability is moderate, and surface runoff is slow. These soils have good tilth and can be worked over a wide range of moisture conditions. The root zone is deep and easily penetrated by plant roots.

In about 50 percent of the area, the Teller soils have been modified by excavating, filling, and grading. Fill material is loamy and usually comes from excavated areas of these soils.

Urban land makes up about 30 percent of the unit. It is used for buildings, streets, houses, and roads. Urban land has very rapid surface runoff.

Included in mapping are small areas of Norge and Vanoss soils. These included soils make up about 20 percent of the unit.

This complex is used for urban development, including industrial sites. The main concerns in using this complex in urban areas are seepage, slope, and moderate permeability. The Teller soils are well suited to trees, garden plants, shrubs, and flowers. This complex has high potential for camp or picnic areas, dwellings, roads, and streets. This complex has medium potential for septic tank absorption fields, small commercial buildings, and playgrounds. It has low potential for paths and trails, sewage lagoons, and trench type sanitary landfills. This complex is well suited to uncoated steel and moderately suited to concrete pipe.

No capability unit or range site has been assigned to this complex.

79—Tussy clay, 3 to 5 percent slopes. This moderately deep, well drained, gently sloping soil is on ridges and side slopes of prairie uplands. Slopes are smooth to irregular and convex. Individual areas are 5 to 60 acres.

Typically, the surface layer is reddish brown clay that extends to a depth of about 6 inches. The subsoil is reddish brown silty clay that extends to a depth of 32 inches. The underlying material is weak red shaly clay to a depth of 60 inches or more.

This soil has a medium available water capacity. Permeability is very slow, and surface runoff is medium to rapid. The root zone is moderately deep, but roots are restricted by the clayey subsoil and underlying material.

Included with this soil in mapping are small areas of Clarita and Chigley soils. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Tussy soil are in range, and some small areas are in tame pasture or crops.

Potential is low for crops. The main concerns for management are slopes, low available water capacity, and severe hazard of erosion. Water erosion can be controlled by keeping an adequate cover of crop residue on the surface. Where this cover is not adequate to control water erosion, terraces are needed. Timely tillage under proper moisture conditions helps maintain good tilth and soil structure. Additional fertilizer should be applied where crop residue is returned to the soil or left on the surface.

This soil has low potential for native grass and tame pasture. Its potential is limited by shallow depth over very limey clays. Bermudagrass and King Ranch or plains bluestem are the main plants used for tame pasture. Quality of native grasses, tame pasture, and hay can be maintained or improved by proper stocking rates, rotation of grazing, deferred grazing, and protection from fire. This soil is subject to severe erosion if a good grass cover is not maintained to protect it.

This soil has low potential for most urban uses. The clayey texture and a high shrink-swell potential are the main limitations for most uses. In some instances these limitations can be overcome by special design and installation.

This soil is in capability subclass IVe and in the Red Clay Prairie range site.

80—Tussy clay, 5 to 20 percent slopes, eroded. This moderately deep, well drained, gently sloping to moderately steep, eroded soil is on side slopes and irregular ridge crests of prairie uplands. The surface layer has been thinned by erosion. The reddish brown subsoil has been exposed on about 15 to 30 percent of the area. On an additional 30 percent of the area, more than half of the original surface layer has been removed by erosion. Gullies are present in some areas. Slopes are smooth to irregular and convex. Individual areas are 5 to 160 acres.

Typically, the surface layer is reddish brown clay that extends to a depth of about 4 inches. The next layer is reddish brown clay that extends to a depth of about 8 inches. The subsoil is reddish brown silty clay that extends to a depth of 32 inches. The underlying material is reddish brown and pale olive silty clay loam to a depth of 60 inches or more.

This soil has a medium available water capacity. Permeability is very slow, and surface runoff is rapid. The root zone is moderately deep, but roots are restricted by the clayey subsoil and underlying material.

Included with this soil in mapping are areas of Clarita and Chigley soils. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

This soil is not suited to crops. Most of this soil is used for range, and some small areas are used for tame pasture.

This soil has low potential for native grasses and tame pasture. Its potential is limited by its shallow depth over very limey clays and the moderately steep slope. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. The quality of native grasses, tame pasture, and hay can be maintained or improved by proper stocking rates, rotation of grazing, deferred grazing, and protection from fire. This soil is subject to severe erosion if a good grass cover is not maintained to protect it.

This soil has low potential for urban uses. The clayey texture and moderately steep slopes are the main limitations for most uses. For some uses the limitations can be overcome by special design and installation.

This soil is in capability subclass VIe and in the Red Clay Prairie range site.

81—Urban land. The areas designated as Urban land on soil maps are within the city boundary of Lindsay and Pauls Valley. Urban land is composed of areas that are more than 75 percent covered with dwellings, commercial buildings, concrete, paved roads, airport runways, refineries, and other similar structures. Slopes are 0 to 1 percent and the areas are more than 40 acres in size. Included in mapping are other soils that are less than 75 percent covered with permanent structures. Areas of these included soils are less than 50 acres in size. No capability unit or range site has been assigned.

82—Vanoss loam, 1 to 3 percent slopes. This deep, well drained, very gently sloping soil is on broad flats and side slopes of high stream terraces of prairie uplands. Slopes are smooth and convex. Individual areas are 10 to 40 acres.

Typically, the surface layer is dark brown loam that extends to a depth of about 12 inches. The upper part of the subsoil is brown silty clay loam that extends to a depth of 44 inches. The lower part of the subsoil is strong brown silty clay loam that extends to a depth of 58 inches. The underlying material is yellowish red silt loam to a depth of 64 inches or more.

This soil has a high available water capacity. Permeability is moderate, and surface runoff is medium to slow. This soil has good tilth and can be worked over a wide range of moisture conditions. The root zone is deep and easily penetrated by plant roots.

Included with this soil in mapping are small areas of soils similar to the Vanoss soil except that they have a thicker surface layer. Also included are small areas of Bethany soils. These included soils make up about 5 percent of the unit, but individual areas are generally less than 5 acres.

Most of this Vanoss soil is used for crops. It is also used for tame pasture and hay. A small acreage is used for range.

This soil has high potential for crops. It is used mainly for grain sorghum and wheat. Controlling water erosion and maintaining desirable soil tilth and fertility are the main concerns of soil management. Water erosion can be controlled by keeping an adequate cover of crop residue on the soil surface. Where this cover is not adequate to control water erosion, terraces are needed.

Timely tillage under proper moisture conditions helps maintain good tilth and soil structure. Additional fertilizer should be applied where crop residue is returned to the soil or left on the surface.

The potential is high for native grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, King Ranch bluestem and plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing when the soil is too wet will cause surface crusting and excessive runoff. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil has medium potential for most urban uses. It has limitations for sanitary disposal systems and sanitary landfills. This soil has a moderate shrink-swell potential that is the main limitation for building development.

This soil is in capability subclass IIe and in the Loamy Prairie range site.

83—Wilson silt loam, 0 to 1 percent slopes. This deep, somewhat poorly drained, nearly level soil is on broad flats of prairie uplands. Slopes are smooth and slightly concave. Individual areas are 30 to 150 acres.

Typically, the surface layer is gray silt loam that extends to a depth of about 8 inches. The upper part of the subsoil is dark gray clay that extends to a depth of 24 inches. The middle part of the subsoil is dark gray clay with brown mottles that extend to a a depth of about 40 inches. The lower part of the subsoil is gray clay with brown mottles that extends to a depth of 50 inches. The underlying material is coarsely mottled, gray and brown clay to a depth of more than 60 inches.

This soil has a high available water capacity. Permeability is very slow, and surface runoff is slow. The water table is perched at a depth of less than 2 feet during winter and spring. The root zone is deep, but the clayey subsoil restricts root growth. Tillage is often limited by excessive surface water.

Included with this soil in mapping on slightly convex landscapes are small areas of Justin and Durant soils. These included soils make up about 10 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Wilson soil are used for crops. Some areas are used for tame pasture and hay. A small acreage is used for range.

This soil has medium potential for crops. It is used primarily for wheat. Providing adequate drainage and maintaining desirable soil tilth and fertility are the main concerns of soil management. Drainage can be improved by proper row direction and shallow field ditches. Returning crop residue and annually applying fertilizer can help maintain fertility on cropland. Timely tillage under proper moisture conditions helps maintain good soil tilth. Additional fertilizer should be applied where crop residue is returned to the soil or left on the surface.

The potential is medium for native grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods are essential to keep the grass and soil in good condition.

This soil has low potential for most urban uses. A high shrink-swell potential and wetness are serious limitations, but they can be overcome by proper design and careful installation. The clayey subsoil is very slowly permeable, which is a limitation for septic tank absorption fields. One alternative would be substituting a sewage lagoon disposal. This soil is in capability class IIIw and in the Claypan Prairie range site.

84—Yahola fine sandy loam, occasionally flooded. This deep, well drained, nearly level soil is on flood plains and is occasionally flooded. Slopes are 0 to 1 percent. Individual areas are 5 to 100 acres.

Typically, the surface layer is reddish brown fine sandy loam that extends to a depth of about 12 inches. The upper part of the underlying material is reddish yellow fine sandy loam that is stratified with coarser and finer materials that extends to a depth of 42 inches. The lower part of the underlying material is reddish yellow loamy fine sand stratified with fine sandy loam to a depth of more than 63 inches.

This soil has a medium available water capacity. Permeability is moderately rapid, and surface runoff is slow. This soil has good tilth and can be worked over a wide range of moisture conditions. It has a deep root zone that is easily penetrated.

Included with this soil in mapping are a few areas of Port and Pulaski soils on the stream tributaries and areas of Keokuk soils on the broad flood plains. Also included are some small areas of intermingled soils that have a silt loam subsoil. These included soils make up about 10 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Yahola soil are used for crops. Some areas are used for tame pasture and hay.

This soil has high potential for most climatically suited crops. It is used mainly for wheat, grain sorghum, and alfalfa. Good tilth can be maintained by returning crop residue to the soil. Diversion terraces help to control runoff from adjacent side slopes, and overflow can be minimized by detention reservoirs upstream.

The potential is high for native grass, tame pasture, and hay. Bermudagrass is the main plant used for tame pasture. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods help to keep the grass and soil in good condition.

The potential is low for most urban uses because of the risk of damaging floods. Flooding is the main limitation for building site development and sanitary facilities. This limitation can be reduced only by major flood-control measures.

This soil is in capability subclass IIw and in the Loamy Bottomland range site.

85—Yahola-Gaddy complex, frequently flooded. This complex consists of nearly level, deep, well drained Yahola soils and nearly level, deep, somewhat excessively drained Gaddy soils. The Yahola soils occur on slightly concave areas; the Gaddy soils occur on adjacent convex areas. Areas of these soils are so intermingled that it was not practical to separate them at the scale selected for mapping. Individual areas are 5 to 100 acres.

The Yahola soils make up about 65 percent of the unit. Typically, the surface layer is reddish brown fine sandy loam that extends to a depth of about 5 inches. The upper part of the underlying material is reddish yellow, stratified fine sandy loam that extends to a depth of 42 inches. The lower part of the underlying material is yellowish red, stratified fine sandy loam to a depth of more than 70 inches.

Yahola soils have a medium available water capacity. Permeability is moderately rapid, and surface runoff is slow. The root zone is deep and easily penetrated.

The Gaddy soils make up about 20 percent of the unit. Typically, the surface layer is brown loamy fine sand that extends to a depth of about 10 inches. The underlying material is reddish yellow, stratified loamy fine sand to a depth of more than 60 inches.

Gaddy soils have a low available water capacity. Permeability is moderately rapid to rapid, and the surface runoff is slow. The root zone is deep and easily penetrated.

Included with this complex in mapping are soils in depressional oxbows that have a silty clay loam surface layer. Also included are similar soils that are redder throughout. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this complex are used for tame pasture and hay. Some areas are left in native vegetation of tall grass and cottonwood, willows, and saltcedar trees. A small acreage is used for crops.

This complex has low potential for crops. The size of the areas and the hazard of frequent flooding limit crop production.

The potential is medium for native grass and high for tame pasture and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. The frequent flooding is a limitation, but upstream flood-control measures have reduced the frequency of flooding to some extent. Tame pasture and hay are effective for controlling erosion. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods can help keep the pasture and soil in good condition.

Because of the risk of damaging floods, this unit should not be considered for residential and urban building sites. Flooding is the main limitation for septic tank absorption fields, sewage lagoons, trench sanitary landfills, roads, and streets.

These Yahola and Gaddy soils are in capability subclass Vw. The Yahola soil is in the Loamy Bottomland range site. The Gaddy soil is in the Sandy Bottomland range site.

86—Zaneis loam, 1 to 3 percent slopes. This deep, well drained, very gently sloping soil is on broad ridgetops and side slopes of prairie uplands. Slopes are convex. Individual areas are 10 to 140 acres.

Typically, the surface layer is dark brown loam that extends to a depth of about 12 inches. The upper part of the subsoil is reddish brown clay loam that extends to a depth of about 30 inches. The middle part of the subsoil is yellowish red clay loam that extends to a depth of about 42 inches. The lower part of the subsoil is red clay loam that extends to a depth of 54 inches. The underlying material is red, interbedded sandstone and sandy shale to a depth of more than 60 inches.

This soil has a high available water capacity. Permeability is moderately slow, and surface runoff is slow to moderate. The root zone is deep and easily penetrated by plant roots.

Included with this soil in mapping are minor areas of Renfrow soils. Also included are minor areas of soils similar to the Zaneis soil except that they have a brownish subsoil. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Zaneis soil are used for tame pasture or range. Some areas are used for crops.

This soil has medium potential for crops. Where this soil is farmed, it is used primarily for small grain crops. The main concerns of soil management are protecting the soil from erosion and maintaining soil tilth and fertility. If crops are grown, terracing, contour farming, high levels of plant residues, and minimum tillage are ways to help control excessive erosion. Additional fertilizer should be applied where crop residue is returned to the soil.

The potential is high for native grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pastures or native grasses are best suited to protecting the soil from eroding. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods can help keep the grass and soil in good condition.

This soil has medium to high potential for most urban uses. It has a moderate shrink-swell potential that is the main limitation for buildings, but this can be overcome by good design and careful installation. The clayey subsoil is moderately slowly permeable, which is a limitation for septic tank absorption fields. This can be overcome by increasing the size of the absorption area or modifying the field.

This soil is in capability subclass IIe and in the Loamy Prairie range site.

87—Zaneis loam, 3 to 5 percent slopes. This deep, well drained, gently sloping soil is on side slopes of prairie uplands. Slopes are convex. Individual areas are 10 to 120 acres.

Typically, the surface layer is reddish brown loam that extends to a depth of about 10 inches. The upper part of the subsoil is reddish brown clay loam that extends to a depth of about 38 inches. The middle part of the subsoil is red clay loam that extends to a depth of about 51 inches. The lower part of the subsoil is light red clay loam that extends to a depth of 57 inches. The underlying material is light red sandy shale to a depth of more than 62 inches.

This soil has a high available water capacity. Permeability is moderately slow, and surface runoff is moderate. The root zone is deep and easily penetrated by plant roots.

Included with this soil in mapping are small areas of Grainola, Lucien, Nash, and Renfrow soils. Also included are areas of soils similar to the Zaneis soil except that they have a brownish subsoil. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Zaneis soil are used for tame pasture or range. Some areas are used for crops.

This soil has medium potential for crops. Where this soil is farmed, it is used primarily for small grains. The main concerns of soil management are protecting the soil from erosion and maintaining soil tilth and fertility. If crops are grown, terracing, contour farming, high levels of plant residues returned to the soil, and minimum tillage are ways to help control excessive erosion. Most crops respond to applications of fertilizers.

The potential is high for native grass, tame pasture, and hay. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pastures or native grasses are best suited to protecting the soil from eroding. Overgrazing or grazing when the soil is too wet will cause surface crusting and excessive runoff. Proper stocking rates, rotation of grazing, deferrred grazing, and restricted use during wet periods can help keep the grass and soil in good condition.

This soil has medium potential for most urban uses. It has a moderate shrink-swell potential that is the main limitation for buildings. This can be overcome by good design and careful installation. The clayey subsoil is moderately slowly permeable, which is a limitation for septic tank absorption fields. This can be overcome by increasing the size of the absorption area or modifying the field.

This soil is in capability subclass IIIe and in the Loamy Prairie range site.

88—Zaneis loam, 2 to 5 percent slopes, eroded. This deep, well drained, very gently sloping to gently sloping, eroded soil is on side slopes of prairie uplands. Slopes are convex. Part of the original surface layer has been removed by erosion in about 70 percent of the area. In about 40 percent of the area, the surface layer and upper part of the subsoil have been mixed by tillage. Rills and gullies are present in some areas. Individual areas are 3 to 200 acres.

Typically, the surface layer is dark brown loam that extends to a depth of about 6 inches. The upper part of the subsoil is reddish brown clay loam that extends to a depth of about 11 inches. The middle part of the subsoil is yellowish red clay loam that extends to a depth of 26 inches. The lower part of the subsoil is red clay loam that extends to a depth of 57 inches. The underlying material is red sandy shale to a depth of more than 62 inches.

This soil has a high available water capacity. Permeability is moderately slow, and surface runoff is moderate. The root zone is deep and easily penetrated by plant roots.

Included with this soil in mapping are minor areas of Lucien, Nash, Renfrow, and Stephenville soils. Also included are small areas of soils similar to the Zaneis soil except that they have a brownish subsoil or a mottled subsoil and intermingled areas of soils that have a high content of sodium in the subsoil. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Zaneis soil are used for tame pasture or range. Some areas are used for cropland.

This soil has medium potential for crops. Where this soil is farmed, it is used primarily for small grains. The main concerns of soil management are protecting the soil from continued erosion and maintaining soil tilth and fertility. If crops are grown, terracing, contour farming, high levels of plant residues returned to the soil, and minimum tillage are ways to help control excessive erosion. Most crops respond to applications of fertilizers. Tame pastures or native grasses are best suited to protecting the soil from eroding.

The potential is medium for native grass, tame pasture, and hay. Bemudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Tame pasture and hay are effective for controlling erosion. Overgrazing or grazing when the soil is too wet will cause excessive runoff. Proper stocking rates, rotation of grazing, deferred grazing, and restricted use during wet periods help to keep the grass and soil in good condition.

This soil has medium potential for most urban uses. A moderate shrink-swell potential and the slope are limitations for buildings, but they can be overcome by good design and careful installation. The clayey subsoil is moderately slowly permeable, which is a limitation for septic tank absorption fields. This can be overcome by increasing the size of the absorption area or modifying the field.

This soil is in capability subclass IIIe and in the Loamy Prairie range site.

89—Zaneis loam, 2 to 5 percent slopes, gullied. This deep, well drained, very gently sloping to gently sloping, gullied soil is on side slopes of prairie uplands. Slopes are convex. Gullies caused by water erosion are 2 to 20 feet in width, 2 to 10 feet in depth, and 30 to 150 feet apart. Most of the original surface layer has been removed by erosion in about 70 percent of the area. In some areas the surface layer has been mixed with the subsoil and represents about 40 to 50 percent of the area. Sandstone is exposed in many of the gullies. Gullies make up about 10 percent of the area. Mapped areas are 5 to 100 acres.

Typically, the surface layer is reddish brown loam that extends to a depth of about 6 inches. The upper part of the subsoil is reddish brown clay loam that extends to a depth of about 10 inches. The middle part of the subsoil is yellowish red clay loam that extends to a depth of about 36 inches. The lower part of the subsoil is reddish brown clay loam that extends to a depth of about 45 inches. The underlying material is reddish brown sandy shale to a depth of more than 62 inches.

This soil has a high available water capacity. Permeability is moderately slow, and surface runoff is rapid. The root zone is deep and easily penetrated by plant roots.

Included with this soil in mapping are small areas of Lucien, Nash, and Renfrow soils. Also included are intermingled areas of soils that have a high content of sodium in the subsoil and soils similar to the Zaneis soil except that they are less than 20 inches deep over bedrock. These included soils make up about 15 percent of the unit, but individual areas are generally less than 5 acres.

Most areas of this Zaneis soil are used for range or tame pasture. This soil is generally no longer suitable for cropland.

The potential is low for native grass, tame pasture, and hay. The main concern in management is protecting the soil from accelerated erosion and improving the soil fertility and structure. Bermudagrass, weeping lovegrass, and King Ranch or plains bluestem are the main plants used for tame pasture. Fertilizing tame pasture plants and legumes for maximum residues helps to reduce soil erosion. Runoff from higher areas should be diverted and banks of gullies shaped before establishing a permanent cover in most areas. Tame pasture is effective for controlling erosion. Tame pasture is difficult to establish because of the deep gullies and little or no topsoil. Overgrazing or grazing when the soil is too wet will cause excessive runoff. Proper stocking rates, rotation of grazing, deferment of grazing, and restricted use during wet periods can help keep the grass and soil in good condition.

This soil has low potential for most urban uses. Soil limitations include the gullied areas, the moderately slow permeability, a moderate shrink-swell potential in the subsoil, and little or no topsoil over much of the area. Most community facilities can be designed to overcome these limitations by good design and careful installation.

This soil is in capability subclass VIe and in the Eroded Prairie range site.

Prime Farmland

The best land for farming is called prime farmland. Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the amount of this high quality farmland is limited, it should be used with wisdom and foresight.

In general, prime farmland is the land that is best suited to producing food, feed, forage, fiber, and oilseed crops. It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops where it is treated and managed with acceptable farming methods. Given minimal inputs of energy and economic resources, prime farmland produces higher yields and causes less damage to the environment than other land.

Prime farmland may now be cropland, pasture, woodland, or anything other than urban and built-up land or water areas. It must either be used for producing food or fiber or be available for these uses.

The soils that make up prime farmland have an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The acidity or alkalinity is suitable. These soils have few, if any, rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods and are not frequently flooded during the growing season (fig. 10). The slope gradient is mostly 0 to 5 percent. More detailed information on the criteria for prime farmland can be obtained from the Soil Conservation Service.

About 42.4 percent of Garvin County, or 220,761 acres, is prime farmland. It is scattered throughout the county, but most is in the central and northwestern parts, in map units 1, 2, 3, 6, and 8 of the general soil map. Approximately 60 percent of this prime farmland is in field crops, 25 percent is tame pasture, 13 percent is rangeland, and 2 percent is woodland. The crops grown on this land are mainly grain sorghum, wheat, corn, alfalfa, peanuts, and soybeans.

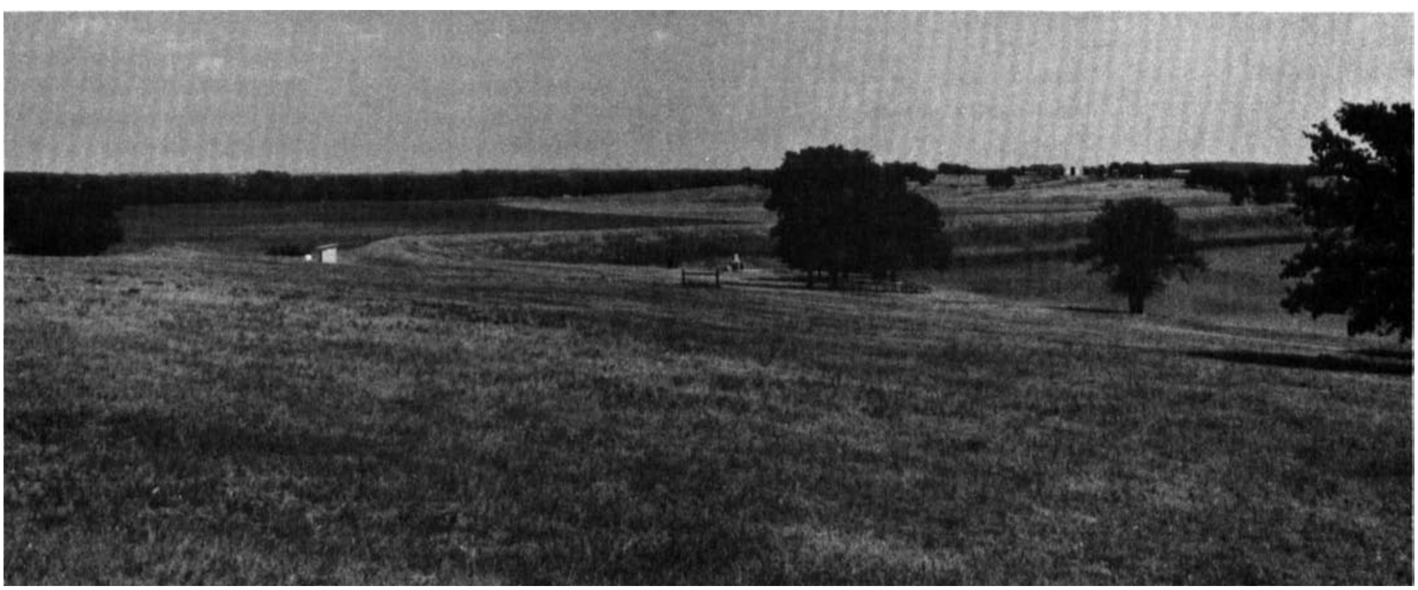

Figure 10.—Flood-control structure protects prime bottomland soils and provides water for livestock, wildlife, and recreation.

A recent trend in some parts of the county has been the conversion of prime farmland to urban uses. Such loss of prime farmland to other uses increases the agricultural use of marginal lands, which are generally more erodible, droughty, and difficult to cultivate and are usually less productive.

The detailed soil map units that make up the prime farmland in Garvin County are listed in this section. This list, however, is not a recommendation for a particular land use. The map units in this list are prime farmland except where they are urban or built-up land. Urban and built-up land is defined as any contiguous unit of land 10 acres or more in size that is used for residences, industrial sites, commercial sites, construction sites, institutional sites, public administration sites, railroad yards, small parks, cemeteries, airports, golf courses, sanitary landfills, sewage treatment plants, water-control structures and spillways, shooting ranges and other such uses.

1 Amber very fine sandy loam, 1 to 3 percent slopes, rarely flooded
2 Asa silty clay loam, occasionally flooded
3 Asher silty clay loam, rarely flooded
5 Bergstrom silt loam, occasionally flooded
6 Bethany silt loam, 0 to 1 percent slopes
7 Bethany silt loam, 1 to 3 percent slopes
8 Burleson clay, 1 to 3 percent slopes
9 Chigley gravelly sandy loam, 1 to 5 percent slopes
12 Clarita clay, 2 to 5 percent slopes
15 Dale silt loam, rarely flooded
17 Durant loam, 0 to 1 percent slopes
18 Durant loam, 1 to 3 percent slopes
21 Elandco silty clay loam, occasionally flooded
22 Galey loamy fine sand, 1 to 3 percent slopes
23 Garvin silty clay loam, occasionally flooded
26 Grainola clay loam, 2 to 5 percent slopes
30 Justin loam, 0 to 1 percent slopes
31 Justin loam, 1 to 3 percent slopes
32 Keokuk silt loam, rarely flooded
38 Konawa fine sandy loam, 1 to 3 percent slopes
41 Konsil loamy fine sand, 0 to 3 percent slopes
44 Lela clay, rarely flooded
48 McLain silty clay loam, rarely flooded
50 Newalla fine sandy loam, 1 to 3 percent slopes
51 Newalla fine sandy loam, 3 to 5 percent slopes
53 Norge silt loam, 0 to 1 percent slopes
54 Norge silt loam, 1 to 3 percent slopes
56 Port fine sandy loam, overwash, occasionally flooded
57 Port silt loam, occasionally flooded
59 Pulaski fine sandy loam, occasionally flooded
61 Renfrow silt loam, 1 to 3 percent slopes
62 Renfrow silt loam, 3 to 5 percent slopes
66 Stephenville fine sandy loam, 1 to 3 percent slopes
67 Stephenville fine sandy loam, 3 to 5 percent slopes
74 Teller loam, 0 to 1 percent slopes
75 Teller loam, 1 to 3 percent slopes
76 Teller loam, 3 to 5 percent slopes
82 Vanoss loam, 1 to 3 percent slopes
84 Yahola fine sandy loam, occasionally flooded
86 Zaneis loam, 1 to 3 percent slopes
87 Zaneis loam, 3 to 5 percent slopes

Use and Management of the Soils

Gary B. Bishop, district conservationist, Soil Conservation Service, helped prepare this section.

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

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

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

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

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

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

Crops and Pasture

Keith Vaughan, conservation agronomist, and Jimmy D. Altom, conservation agronomist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; 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 listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Crops

More than 185,000 acres in Garvin County was used for crops and pasture in 1974, according to a Soil Conservation Service land use inventory. Of this total, 89,000 acres was used for pasture; 7,680 acres for row crops; 48,960 acres for close-growing crops, mainly wheat and oats; and 39,360 acres for rotation alfalfa hay and pasture. The remainder was used for other crops.

The soils in Garvin County have good potential for increased production of food. Much land suitable for crops is currently used as rangeland or pasture. Food production could also be increased by more widespread use of the latest crop production technology.

Acreage in cropland and woodland has been gradually decreasing as more and more land is used for urban structures. In 1974 about 7,300 acres in the county was used as urban and built-up, and this usage has been increasing at the rate of about 20 acres per year.

Soil erosion is a major concern on the existing cropland in Garvin County. Erosion is generally a hazard where the slope is more than 1 percent. The Amber, Bethany, Burleson, Chigley, Durant, Konawa, Renfrow, and Teller soils, for example, have slopes of 1 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 that have a clayey subsoil, such as the Durant, Renfrow, Clarita, and Tussy soils. Second, soil erosion on farmland results in sedimentation of streams and a decrease in the quality of water for municipal use, for recreation, and for fish and wildlife.

Most erosion control practices provide protective surface cover, reduce runoff, and increase water infiltration. A cropping system that keeps plant cover on the soil for extended periods can hold soil losses to amounts that will not reduce the productive capacity of the soils. Minimizing tillage and leaving crop residue on the soil can increase infiltration and reduce the hazards of runoff and erosion.

Terraces and diversions can be constructed on many soils to reduce the length of slope and reduce runoff and erosion. Durant soils, for example, are suitable for terraces. Grainola soils are less suitable for terraces and diversions because of bedrock at a depth of less than 40 inches. Terraces and diversions are not practical on deep sandy soils.

Contouring and contour stripcropping are also effective erosion control practices. They are best suited to soils that have smooth uniform slopes, including most areas of the Burleson, Chigley, Durant, Konawa, Teller, Vanoss, and Wilson soils.

Soil blowing is a hazard on Konawa or Konsil loamy fine sand in some areas. Soil blowing can damage these soils when winds are strong and the soils are dry and bare of vegetation or surface mulch. Maintaining plant cover, surface mulch, or rough surfaces through tillage minimizes soil blowing on these soils. Information for the design of erosion controls for each kind of soil is available at local offices of the Soil Conservation Service.

Field crops suited to the soils and climate of the county include many that are not now commonly grown. Cotton, grain sorghum, and soybeans are the main row crops. Guar, sunflowers, mung beans, broomcorn, potatoes, and similar crops can be grown. Wheat and alfalfa are common close-growing crops. Rye and oats can be grown. Seed can be produced from alfalfa, plains bluestem, and weeping lovegrass. Alfalfa and bermudagrass are the most commonly grown hay crops.

Special crops are grown mostly on areas of the Justin, Konawa, and Galey soils. These include vegetables, small fruits, tree fruits, and nursery plants. A small acreage throughout the county is used for melons, strawberries, sweet corn, tomatoes, peppers, and other vegetables and small fruits. Pecans are another important crop.

Tame Pasture

Zelan K. Vaughan, conservation agronomist, Soil Conservation Service, and Earl Weisner, district conservationist, Soil Conservation Service, helped prepare this section.

About 13 percent of Garvin County is used for tame pasture. Many fields formerly used for crops have been converted or are being converted to tame pasture. Small areas of native range that are in poor condition are also being converted to tame pasture.

Most of the soils in the county are suited to tame pasture. The principal tame pasture grasses are improved bermudagrass, weeping lovegrass, King Ranch bluestem, and plains bluestem.

Bermudagrass pasture is occasionally overseeded with rye, winter wheat, ryegrass, or fescue to provide grazing late in fall and early in spring. In some pastures the bermudagrass is overseeded with a cool-season legume, such as hairy vetch.

Weeping lovegrass, an important grass in the county (fig. 11), is best suited to well drained sandy or loamy soils, such as Konawa, Konsil, or Gailey soils. It supplies abundant summer forage but must be carefully managed in order to keep it palatable to livestock.

King Ranch bluestem, a common pasture grass in some parts of the county, is best suited to the more clayey soils, such as Burleson, Clarita, and Grainola soils. It is difficult to establish, but it is drought resistant.

Sudangrass and hybrid forage sorghums are grown for hay and pasture in some parts of the county. These grasses are commonly planted on soils in the flood plains, such as the Bergstrom, Elandco, Pulaski, and Port soils, for supplemental summer grazing.

Tall fescue is best suited to the soils on flood plains that have large amounts of available moisture. On these soils, fescue produces about the same amount of forage as bermudagrass. Fescue furnishes some fall and winter grazing, but the best production is early in spring. Maintaining a vigorous stand of fescue on the soils in the uplands is difficult.

Winter small grain combinations, such as rye and ryegrass and vetch and rye, are used on some cropland soils to provide winter and spring forage. These crops are harvested for grain or hay. Usually they are grazed.

Bermudagrass is grown throughout the county. For maximum production, bermudagrass should be regularly fertilized in split applications of 50 pounds per acre of actual nitrogen every 30 days if moisture is available. Hairy vetch can be overseeded in the bermudagrass to provide higher quality forage in winter and early in spring. The vetch should be inoculated to help provide some of the nitrogen requirement of the bermudagrass.

For maximum production, bermudagrass, lovegrass, and native grasses should be fenced and managed in separate pastures. Fencing allows maximum utilization of the forage without the cattle overgrazing one grass and undergrazing another.

Proper grazing and rotation grazing will help lengthen the life of most pasture plants. Deferred grazing is especially beneficial during periods of low food reserve. This allows plants to regain vigor by maintaining a more adequate root system where food can be stored for the next growing season. As a result, the total production of forage will be increased.

Increasing the fertility of the soil results in more vigorous pasture plants and lengthens the lifespan of the plants. This increases forage production. Plant nutrients can be added by using commercial fertilizers. Legumes such as vetch and alfalfa can be seeded in bermudagrass to furnish nitrogen. Larger amounts of

Figure 11.—Lovegrass in a previously cultivated area of Renfrow silt loam, 2 to 5 percent slopes, eroded.

nitrogen fertilizer are needed where legumes are not grown with the grass.

The desired kind of pasture plants can be maintained in the stand only if the invasion of undesirable plants is controlled. Brush management is essential. A proper mowing or spraying program can reduce the problem created by weeds and brush.

A good pasture program provides the desired amount of forage during each month of the year. To attain this requires a knowledge of the different growing seasons of the various kinds of forage plants. Figure 12 shows for the common forage plants the percentage of annual growth that can be safely grazed each month without substantially reducing the total yield. For example, 26 percent of the yearly growth of bermudagrass can be safely grazed during June.

Soils vary in their ability to produce forage for grazing. The Bethany soils produce more forage than Durant soils, primarily because they furnish more available moisture to the plant. Table 5 gives in animal-unit-months the total yearly production of various kinds of pasture plants on each soil. An animal-unit-month (AUM) is the amount of forage or feed required to feed one animal unit (one cow, one horse, five sheep, or five goats) for 30 days. For example, Bethany silt loam, 0 to 1 percent slopes, in bermudagrass pasture, will produce forage for 7 AUM during a year.

In planning a pasture program, consider both the total yearly production of the pasture plant in AUM (table 5) and the amount of growth available each month (fig. 12). In the example, bermudagrass furnishes 26 percent of its

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Improved Bermudagrass				4	22	26	18	12	12	6		
Tall Fescue	2	6	14	25	14	3			10	16	7	3
Bermudagrass-Tall Fescue Combination	2	4	14	19	14	14	6	4	6	10	5	2
Weeping Lovegrass			2	17	25	20	14	8	8	4	2	
Caucasian or Plains Bluestem				4	6	12	18	22	24	12	2	
King Ranch Bluestem				2	10	20	22	20	14	10	2	
Native Grass	1	1	4	10	18	24	16	9	11	4	1	1
Forage Sorghum						14	30	30	20	6		
Small Grain Grazeout	1	7	22	32	25	5				3	4	1
Native Grass	1	1	1	6	21	27	18	6	8	8	2	1

Figure 12.—Percentage of annual pasture growth that can be safely grazed each month.

annual forage during June. Bermudagrass on the Bethany soil can provide grazing for 1.8 animal units (.26 x 7 AUM = 1.8 AUM) during June since its yearly production is 7 AUM. A 50-acre pasture of bermudagrass on Bethany soil would then furnish grazing for 90 animal units (50 x 1.8 AUM = 90 AUM) during June. Personnel of the Soil Conservation Service or the Cooperative Extension Service can assist in planning a total pasture program.

Periods of low rainfall are common in Garvin County. They may last for a month or more, or rainfall may be below normal for a year or more. The yields in table 5 are averages over several years. To ensure continuous, adequate forage during these dry periods, either the number of livestock must be reduced or a feed reserve is needed. A feed reserve can be provided in two ways: by harvesting part of the pasture for hay during periods of above-normal moisture and by withholding areas from grazing until a later period. For example, grazing of a reserve pasture of bermudagrass grown in May and June can be delayed until a dry period in August and September, which occurs occasionally. Close grazing during August and September should be avoided, however, because this is the period when storage roots develop to help the plants survive the winter.

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 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

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

In the capability system, soils are generally grouped at two levels: capability class and subclass. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

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. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

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

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

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

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

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

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

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

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main 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 very cold or very dry.

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

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 or IIIe-6.

The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Rangeland

Ernest C. Snook, range conservationist, Soil Conservation Service, helped prepare this section.

Rangeland is land on which the native vegetation consists of a wide variety of grasses, grasslike plants, forbs, shrubs, and trees. The vegetative species are generally suitable for grazing and occur in sufficient amounts to be used for grazing. Rangeland, or native grassland, receives no regular or frequent cultural treatment. The composition and production of the plant community is determined by the soil, climate, topography, overstory canopy, and grazing practices.

According to records of the local office of the Soil Conservation Service, 54 percent of Garvin County is rangeland and about 90 percent of the farm income is derived from livestock. The original range vegetation produced a wide variety of tall and mid-growing grasses interspersed with an abundance of forbs.

Three general types of rangeland exist in the county. In the eastern and western parts of the county most of the soils are loamy and deep to shallow over sandstone. These soils support post oak and blackjack savannah vegetation with an understory of mid and tall grasses. Potential productivity is high on the moderately deep and deep soils. In the central part of the county the soils are loamy and clayey and are shallow to deep over shale, clayey sediments, or sandstone. The potential is high for mid and tall grasses on the moderately deep to deep soils. Along the Washita River and its tributaries, most of the soils are deep and loamy or clayey. These soils have been cleared of hardwoods and are presently being cultivated throughout most of the area. Small areas of native vegetation have high potential for producing tall grasses.

The plant community of the rangeland has changed drastically over the past 50 years. Heavy grazing has deteriorated much of the grasslands, and much of the high-quality vegetation has been grazed out. Some depleted cropland has been returned to native grasslands. Areas that were once open grasslands, supporting tall productive grasses, are now covered with scattered post oak and a mixture of short and mid grasses and poor-quality forbs. The amount of forage presently produced may be less than half of that originally produced. Remnants of the original plant species are still found, however, in protected areas on most grasslands, and good grazing management usually will allow these high-quality plants to become reestablished.

Although most of the local ranches and livestock farms are cow-calf operations, there are some stocker-calf enterprises. Many ranches supplement their herds with stockers. This provides greater flexibility for adjusting the number of livestock to be cared for in periods of drought.

Ranches generally supplement the grazing of native grassland with the grazing of improved pasture and cropland. Improved bermudagrass, plains bluestem, and weeping lovegrass are commonly grown in improved pastures. Protein supplements, hay, and grazing of small grain are used to help feed livestock throughout the winter.

Approximately 75 percent of the annual forage yield is produced in April, May, and June when spring rains and moderate temperatures are favorable for the growth of warm-season plants. A secondary growth period generally occurs in September and October when fall rains and gradually cooling temperatures are common.

Droughts of varying length are frequent in this area. Short midsummer droughts usually occur every year. Frequently, longer periods of drought last for several months.

Range Sites and Condition Classes

A range site is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other sites in kind, amount, and proportion of range plants. The relationship between the soils and the vegetation was studied during this survey, and range sites generally vary with the soil map units. The soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and depth to the seasonal high water table are also important.

The climax vegetation on a range site is the stabilized plant community that the site is capable of producing. It consists of the plants that were growing there before the region was settled. This plant community reproduces itself and changes very little as long as the environment remains unchanged. If cultivated crops are not grown, the most productive combination of forage plants on a range site is generally the climax vegetation.

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

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

Invaders are undesirable plants that cannot compete with plants in the climax plant community for moisture, nutrients, and light. Invaders grow along with increasers, however, if the climax vegetation has been reduced by grazing. Some invaders have fair value for grazing.

The range condition of a particular site is judged according to the present kind and amount of vegetation in relation to the climax plant community for that range site. Four classes are used to indicate the degree of departure from the potential, or climax, vegetation. A range is in *excellent* condition if 76 to 100 percent of the vegetation is of the same kind as that in the climax stand; in *good* condition if the percentage is 51 to 75; in *fair* condition if the percentage is 26 to 50; and in *poor* condition if the percentage is 25 or less.

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

Table 7 shows, for each soil, the range site and the total annual production of vegetation in favorable, normal, and unfavorable years. Only those soils that are used as, or are suited to, rangeland are listed. Yields are given in dry weight, which is the total annual production reduced to a common percent of air-dry moisture content.

The primary objective of good range management is to keep the range in excellent or good condition (fig. 13). If the range is well managed, water is conserved, yields are improved, and the soils are protected. The main management concern is recognizing important changes in the plant cover on a range site. Changes in plant cover take place gradually and can be easily misinterpreted or overlooked. Growth encouraged by heavy rainfall could lead to a false conclusion that the range is in good condition even though the cover is weedy and the long-term trend is toward lower production. On the other hand, some rangeland that has been closely grazed for short periods under the supervision of a careful manager may have a degraded appearance that temporarily conceals its quality and its ability to recover. If the rangeland is overused for years, seed sources of the desirable vegetation will be eliminated and the vegetation will have to be reestablished.

Range management practices suitable for Garvin County are proper grazing use, deferred grazing, or a planned grazing system. Other, facilitating practices that benefit management are stock water development, fencing, and salting and feeding locations. When regression has occurred or is occurring and undesirable plants dominate, the acceleration of practices such as range seeding, brush management, weed management, and prescribed burning should be considered singly or in combination with management and facilitating practices.

If properly applied and maintained, these practices generally result in optimum production of vegetation, reduction of undesirable species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

The following information contains guidelines for potential annual utilization on a broad scale. When more detail is needed, consult the Soil Conservation Service for a particular area or situation.

To maintain or improve the quality and quantity of native vegetation, the amount of forage that can be safely removed depends on the potential productivity and condition of the site. As a general rule, approximately 50 percent of the annual season's growth should be left on the soil surface. This amount is equal to one-third of the height of the vegetative parts of tall and mid grasses, and if this amount is left on the site it is enough to protect the natural resources.

Annual growth can be removed in a number of ways, such as by living organisms, rodents, insects, mammals, and deterioration caused by climatic variations. Generally, mammals such as livestock remove approximately 50 percent of the growth from the site, or 25 percent of the total annual growth by weight. For example, the forage available for livestock on a Claypan Prairie range site, map units 61 and 62, in excellent condition for an average growing season, would be 2,800 pounds of air-dry vegetative material. This 2,800 pounds includes all production of grasses, forbs, and woody species. The percentage makeup by grasses, forbs, and woody species are listed in the individual range site descriptions. Approximately 25 percent of this

Figure 13.—Sandy Savannah range site in excellent condition on Stephenville fine sandy loam, 3 to 5 percent slopes.

2,800 pounds, or 700 pounds of the average productivity of grasses and forbs is available for livestock forage. Woody plants are not generally considered livestock forage. A 1,000-pound cow, which is one animal unit, will consume 2 1/2 to 3 percent of its weight in forage per day, or 25 to 30 pounds of air-dry forage. So in one month (30 days), it will consume 750 to 900 pounds of native vegetation, mainly grass, depending on quality and stage of growth.

To determine the number of days of forage available for an animal unit on one acre of Claypan Prairie range site in excellent condition, divide the 700 pounds of available forage by the 25 to 30 pounds required for an animal unit per day. Thus one acre will produce forage for one animal unit for 23 to 28 days. To determine the animal unit months, divide the available forage (700 lbs.) by the forage requirement for an animal unit per month (750—900 lbs). Thus one acre of range in this example would provide forage for .78 to .93 animal-unit-months (AUM). In other words, grazing a cow for a year would require 13.0 to 15.4 acres of a Claypan Prairie range site in excellent condition.

There are 15 range sites in Garvin County. These are the Blackclay Prairie, Claypan Prairie, Deep Sand Savannah, Eroded Clay, Eroded Prairie, Eroded Sandy Savannah, Heavy Bottomland, Loamy Bottomland, Loamy Prairie, Redclay Prairie, Sandy Bottomland, Sandy Savannah, Shallow Prairie, Shallow Savannah, and Subirrigated range sites.

Blackclay Prairie

The potential plant community on this range site is a tall-mid grass aspect. It is by weight 95 percent grasses, 4 percent forbs, and 1 percent woody plants.

Big bluestem, little bluestem, indiangrass, switchgrass, eastern gamagrass, leadplant, compassplant, and Maximilian sunflower are preferred plants that make up 80 percent of the livestock forage production when this site is in excellent condition. The preferred plants disappear under continuous heavy grazing and are replaced by desirable plants such as meadow and tall dropseed, sideoats grama, buffalograss, hairy grama, Texas wintergrass, scurfpea, and heath aster.

Continued overgrazing and extreme climatic conditions can cause a decrease in the desirable plants. If regression occurs, undesirable plants such as silver bluestem, Texas grama, windmillgrass, annual grasses, western ragweed, common broomweed, basketflower, ironweed, mesquite, and persimmon gradually dominate the site. As undesirable plants increase, the potential forage production is reduced.

The Burleson and Clarita soils in map units 8, 12, 13, and 14 are in this site.

Claypan Prairie

The potential plant community on this range site is a mid-tall grass aspect. It is by weight 96 percent grasses and 4 percent forbs.

Big bluestem, indiangrass, switchgrass, little bluestem, vine-mesquite, western wheatgrass, dotted gayfeather, and perennial sunflowers are preferred plants that make up 60 percent of the livestock forage production when this site is in excellent condition. The preferred plants disappear under continuous heavy grazing and are replaced by desirable plants such as sideoats grama, blue grama, silver bluestem, lovegrasses, dropseeds, buffalograss, Texas grama, fall witchgrass, neptunia, scurfpea, sagewort, ragweed, goldaster, and gumweed.

Continued overgrazing and extreme climatic conditions can cause a decrease in the desirable plants. If regression occurs, undesirable plants such as threeawns, annual cool-season grasses, broomweed, gaillardia, pricklypear cactus, and mesquite gradually dominate the site. As undesirable plants increase, the potential forage production is reduced.

The Renfrow and Wilson soils in map units 61, 62, 63, and 83 are in this site.

Deep Sand Savannah

The potential plant community is by weight 85 percent grasses, 5 percent forbs, and 10 percent woody plants.

Big bluestem, indiangrass, switchgrass, little bluestem, broadleaf uniola, beaked panicum, wildrye, lespedeza, and grape are preferred plants that make up 80 percent of the livestock forage production when this site is in excellent condition. The preferred plants disappear under continuous heavy grazing and are replaced by desirable plants such as purpletop, dropseeds, sideoats grama, lovegrasses, Scribner panicum, fringeleaf paspalum, sagewort, snakecotton, beebalm, oak, skunkbush, and sumac.

Continued overgrazing and extreme climatic conditions can cause a decrease in the desirable plants, and oak sprouts fill in the space vacated. In this condition, this site is sometimes mistakenly classified as forestland. If regression occurs, undesirable plants such as broomsedge bluestem, splitbeard bluestem, annual threeawn, annual brome, showy partridgepea, ragweeds, white snakeroot, silver bluestem, lovegrass, camphorweed, annual wild-buckwheat, and horseweed fleabane gradually dominate the site. As undesirable plants increase, the potential forage production is reduced.

The Galey, Konawa, and Konsil soils in map units 22, 34, 35, 37, 41, and 42 are in this site.

Eroded Clay

The potential plant community on this range site is difficult to determine because it results from alteration of other sites. Generally a short grass aspect and in some places mid and tall grasses can be grown. The potential plant community is by weight 94 percent grasses, 5 percent forbs, and 1 percent woody plants. Blue grama, sideoats grama, western wheatgrass, vine-mesquite, and tall dropseed are preferred plants that make up 60 percent of the livestock forage production when this site is in excellent condition. The preferred plants disappear under continuous heavy grazing and are replaced by desirable plants such as buffalograss, silver bluestem, fall witchgrass, lovegrasses, Texas grama, slimflower scurfpea, prairie sagewort, hairy goldaster, sumac, and coralberry.

Continued overgrazing and extreme climatic conditions can cause a decrease in the desirable plants. If regression occurs, undesirable plants such as annual threeawns, whorled dropseed, little barley, windmillgrass, wax goldenweed, annual broomweed, annual gaillardia, and mesquite gradually dominate the site. As undesirable plants increase, the potential forage production is reduced and soil loss is evident.

The Renfrow soil in map unit 64 is in this site.

Eroded Prairie

This range site is generally formerly cultivated land. The potential plant community is difficult to determine because it results from alteration of other sites. Generally a short grass aspect and in some places mid and tall grasses can be grown. The potential plant community is a mid-tall grass aspect that is by weight 96 percent grasses, 3 percent forbs, and 1 percent woody plants.

Little bluestem, indiangrass along with some switchgrass, big bluestem, prairie-clover, tickclover, scurfpea, sensitive brier, gayfeather, perennial sunflower, and skunkbush are preferred plants that make up 60 percent of the livestock forage production when this site is in excellent condition. The preferred plants disappear under continuous heavy grazing and are replaced by desirable plants such as dropseeds, sideoats grama, hairy grama, silver bluestem, Scribner panicum, scurfpea, dalea, heath aster, goldenrod, coralberry, sumac, and blackberry.

Continued overgrazing and extreme climatic conditions can cause a decrease in the desirable plants. If regression occurs, undesirable plants such as splitbeard bluestem, broomsedge bluestem, threeawn, annual bromes, common broomweed, ragweeds, persimmon, and oak gradually dominate the site. As undesirable plants increase, the potential forage production is reduced.

The Clarita, Durant, Teller, and Zaneis soils in map units 11, 20, 73, and 89 are in this site.

Eroded Sandy Savannah

This range site is formerly cultivated and eroded sandy soils on uplands. The potential plant community is difficult to determine because it results from alteration of other sites. Generally a mid grass aspect and in some places tall grasses can be grown.

The potential plant community is by weight 94 percent grasses, 3 percent forbs, and 3 percent woody plants.

Little bluestem, indiangrass along with some switchgrass, big bluestem, tickclover, Illinois bundleflower, prairie-clover, ashy sunflower, and pitchersage are preferred plants that make up 60 percent of the livestock forage when this site is in excellent condition. The preferred plants disappear under continuous heavy grazing and are replaced by desirable plants such as sideoats grama, purpletop, tall dropseed, fall witchgrass, purple lovegrass, heath aster, and prairie sagewort.

Continued overgrazing and extreme climatic conditions can cause a decrease in the desirable plants. If regression occurs, undesirable plants such as silver bluestem, splitbeard bluestem, threeawns, lovegrasses, sand dropseed, western ragweed, ironweed, post oak, blackjack oak, sumac, coralberry, and persimmon gradually dominate the site. As undesirable plants increase, the potential forage production is reduced.

The Chigley, Konawa, Konsil, Newalla, and Stephenville soils in map units 11, 36, 43, and 70 are in this site.

Heavy Bottomland

The potential plant community on this range site is by weight 95 percent grasses, 3 percent forbs, and 2 percent woody plants.

Switchgrass, prairie cordgrass, eastern gamagrass, Virginia wildrye, vine-mesquite, broadleaf uniola, rosinweed, and perennial sunflowers are preferred plants that make up 70 percent of the livestock forage production when this site is in excellent condition. The preferred plants disappear under continuous heavy grazing and are replaced by desirable plants such as tall dropseed, purpletop, longspike tridens, white tridens, buffalograss, knotroot bristlegrass, Texas wintergrass, sedges, wild alfalfa, heath aster, goldenrod, greenbrier, roughleaf dogwood, elm, oak, and sumac.

Continued overgrazing and extreme climatic conditions can cause a decrease in the desirable plants. If regression occurs, undesirable plants such as windmillgrass, tumblegrass, broomsedge bluestem, silver bluestem, threeawn, annual brome, curly dock, seacoast sumpweed, ragweeds, cocklebur, ironweed, white snakeroot, pecan, persimmon, and mesquite gradually dominate the site. As undesirable plants increase, the potential forage production is reduced.

The Garvin, McLain, and Lela soils in map units 23, 24, 44, and 48 are in this site.

Loamy Bottomland

The potential plant community is a tall warm-season and mid cool-season grass aspect that is by weight 93 percent grasses, 3 percent forbs, and 4 percent woody plants.

Big bluestem, switchgrass, indiangrass, eastern gamagrass, little bluestem, wildryes, western wheatgrass, tickclover, Illinois bundleflower, perennial sunflowers, wholeleaf rosinweed, poison-ivy, and grape are preferred plants that make up 80 percent of the livestock forage production when this site is in excellent condition. The preferred plants disappear under continuous heavy grazing and are replaced by desirable plants such as tall dropseed, purpletop, sideoats grama, knotroot bristlegrass, sedges, Texas bluegrass, heath aster, goldenrod, and prairie sagewort, and along streambanks by elm, pecan, oak, cottonwood, green ash, redbud, roughleaf dogwood, greenbrier, and coralberry.

Continued overgrazing and extreme climatic conditions can cause a decrease in the desirable plants. If regression occurs, undesirable plants such as silver bluestem, windmillgrass, tumblegrass, dropseeds, buffalograss, broomsedge bluestem, trailing wildbean, camphorweed, ragweeds, ironweed, mesquite, black willow, and hawthorn gradually dominate the site. As undesirable plants increase, the potential forage production is reduced.

The Amber, Asa, Asher, Bergstrom, Dale, Elandco, Keokuk, Port, Pulaski, and Yahola soils in map units 1, 2, 3, 5, 15, 21, 24, 32, 56, 57, 58, 59, 84, and 85 are in this site.

Loamy Prairie

The potential plant community on this range site is a tall grass aspect that is by weight 96 percent grasses, 3 percent forbs, and 1 percent woody plants.

Big bluestem, indiangrass, switchgrass, little bluestem, wildrye, leadplant, prairie acacia, sensitivebrier, perennial sunflower, Engelmann-daisy, compassplant, and prairie rose are preferred plants that make up 80 percent of the livestock forage production when this site is in excellent condition. The preferred plants disappear under continuous heavy grazing and are replaced by desirable plants such as tall dropseed, meadow dropseed, sideoats grama, Scribner panicum, blue grama, fall witchgrass, jointtail, wild-indigo, wild alfalfa, heath aster, prairie sagewort, goldenrod, elm, coralberry, greenbrier, and sumac.

Continued overgrazing and extreme climatic conditions can cause a decrease in the desirable plants. If regression occurs, undesirable plants such as silver bluestem, splitbeard bluestem, broomsedge bluestem, windmillgrass, threeawn, annual brome, common broomweed, western ragweed, plantain, mesquite, and persimmon gradually dominate the site. As undesirable plants increase, the potential forage production is reduced.

The Bethany, Durant, Justin, Nash, Norge, Teller, Vanoss, and Zaneis soils in map units 6, 7, 17, 18, 19, 30, 31, 47, 53, 54, 71, 72, 74, 75, 76, 82, 86, 87, and 88 are in this site.

Redclay Prairie

The potential plant community on this range site is a mid and tall grass aspect. It is by weight 97 percent grasses and 3 percent forbs.

Little bluestem, big bluestem, indiangrass, prairie-clover, trailing ratany, prairie bundleflower, gayfeathers, Engelmann-daisy, perennial sunflower, and prairie rose are preferred plants that make up 55 percent of the livestock forage production when this site is in excellent condition. The preferred plants disappear under continuous heavy grazing and are replaced by desirable plants such as sideoats grama, dropseeds, Scribner panicum, blue grama, buffalograss, silver bluestem, hairy grama, tall grama, scurfpea, lespedeza, heath aster, goldenrod, hackberry, elm, and sumac.

Continued overgrazing and extreme climatic conditions can cause a decrease in the desirable plants. If regression occurs, undesirable plants such as hairy tridens, splitbeard bluestem, threeawn, annual bromes, common broomweed, croton, ragweeds, persimmon, and hawthorn gradually dominate the site. As undesirable plants increase, the potential forage production is reduced.

The Tussy soil in map units 79 and 80 is in this site.

Sandy Bottomland

The potential plant community on this range site is by weight 93 percent grasses, 3 percent forbs, and 4 percent woody plants.

Switchgrass, indiangrass, big bluestem, eastern gamagrass, Illinois bundleflower, wholeleaf rosinweed, perennial sunflower, sand plum, and poison-ivy are preferred plants that make up 60 percent of the livestock forage production when this site is in excellent condition. The preferred plants disappear under continuous heavy grazing and are replaced by desirable plants such as little bluestem, dropseeds, Scribner panicum, purpletop, heath aster, goldenrod, elm, sumac, willow, and cottonwood.

Continued overgrazing and extreme climatic conditions can cause a decrease in the desirable plants. If regression occurs, undesirable plants such as threeawns, broomsedge bluestem, lovegrass, seacoast sumpweed, ragweeds, ironweeds, white snakeroot, and persimmon gradually dominate the site. As undesirable plants increase, the potential forage production is reduced.

The Gaddy soil in map unit 85 is in this site.

Sandy Savannah

The potential plant community on this range site is a tall and mid grass aspect. It is by weight 87 percent grasses, 3 percent forbs, and 10 percent woody plants.

Big bluestem, little bluestem, indiangrass, switchgrass, wildryes, tickclover, perennial lespedeza, ashy sunflower, poison-ivy, and grape are preferred plants that make up 65 percent of the livestock forage production when this site is in excellent condition. The preferred plants disappear under continuous heavy grazing and are replaced by desirable plants such as purpletop, sideoats grama, purple lovegrass, fringeleaf paspalum, tall dropseed, fall witchgrass, flatsedge, heath aster, prairie sagewort, goldenrod, post oak, blackjack oak, elm, sumac, blackberry, and hickory.

Continued overgrazing and extreme climatic conditions can cause a decrease in the desirable plants. If regression occurs, undesirable plants such as silver bluestem, broomsedge bluestem, splitbeard bluestem, dropseeds, lovegrasses, threeawns, annual broomweed, western ragweed, bitter sneezeweed, camphorweed, hawthorn, and mesquite gradually dominate the site. As undesirable plants increase, the potential forage production is reduced.

The Chigley, Konawa, Newalla, and Stephenville soils in map units 9, 10, 38, 39, 40, 50, 51, 52, 66, 67, 68, and 69 are in this site.

Shallow Prairie

The potential plant community on this range site is a mid and tall grass aspect. It is by weight 92 percent grasses, 5 percent forbs, and 3 percent woody plants.

Little bluestem, indiangrass, big bluestem, switchgrass, sensitivebrier, prairie scurfpea, blacksamson, perennial sunflower, and skunkbush are preferred plants that make up 65 percent of the livestock forage production when this site is in excellent condition (fig. 14). The preferred plants disappear under continuous heavy grazing and are replaced by desirable plants such as sideoats grama, hairy grama, tall grama, dropseeds, Scribner panicum, wild-indigo, heath aster, goldenrod, coralberry, and sumac.

Continued overgrazing and extreme climatic conditions can cause a decrease in the desirable plants. If regression occurs, undesirable plants such as silver bluestem, windmillgrass, tumblegrass, broomsedge bluestem, annual bromes, threeawns, annual broomweed, ragweeds, bitter sneezeweed, persimmon, mesquite, juniper, and pricklypear cactus gradually dominate the site (fig. 15). As undesirable plants increase, the potential forage production is reduced.

The Grainola, Loco, Lucien, and Rayford soils in map units 26, 27, 28, 45, 46, 47, and 60 are in this site.

Figure 14.—Shallow Prairie range site in fair condition on Lucien stony loam, 12 to 30 percent slopes.

Shallow Savannah

The potential plant community on this range site is by weight 88 percent grasses, 4 percent forbs, and 8 percent woody plants.

Big bluestem, indiangrass, little bluestem, switchgrass, Canada wildrye, perennial lespedeza, prairie-clover, Virginia tephrosia, perennial sunflower, pitchersage, and gayfeather are preferred plants that make up 65 percent of the livestock forage production when this site is in excellent condition. The preferred plants disappear under continuous heavy grazing and are replaced by desirable plants such as sideoats grama, hairy grama, dropseeds, purpletop, fringeleaf paspalum, heath aster, prairie sagewort, post oak, blackjack oak, sumac, elms, and coralberry.

Continued overgrazing and extreme climatic conditions can cause a decrease in the desirable plants. If regression occurs, undesirable plants such as silver bluestem, splitbeard bluestem, lovegrasses, western ragweed, bitter sneezeweed, and numerous annual weedy grasses and forbs gradually dominate the site. As undesirable plants increase, the potential forage production is reduced.

The Darnell soil in map unit 69 is in this site.

Subirrigated

The potential plant community on this range site is a mid and tall grass aspect. It is by weight 97 percent grass, 2 percent forbs, and 1 percent woody plants. Big bluestem, switchgrass, indiangrass, and western wheatgrass are preferred plants that make up 70 percent or more of the livestock forage production when this site is in excellent condition. Other preferred plants, such as little bluestem and alkali sacaton, are present but are confined largely to the high islands in the irregular micro-relief topography. The preferred plants disappear first under continuous or heavy grazing and are replaced by desirable plants such as inland saltgrass, silver bluestem, annual brome, and buffalograss.

Continued overgrazing and extreme climatic conditions cause a decrease in the desirable plants. When regression of the plant community occurs, undesirable plants such as whorled dropseed, western ragweed, annual grasses and weeds, kochia and tamarisk (saltcedar) dominate the site. When undesirable plants are present, the potential forage production is greatly reduced and woody species increase.

The Gracemont soil in map unit 25 is in this site.

Windbreaks and Environmental Plantings

Norman E. Smola, forester, Soil Conservation Service, helped prepare this section.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well-prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil

Figure 15.—Buffalograss, pricklypear cactus, and juniper are dominant in overgrazed areas of Rayford cobbly loam, 5 to 20 percent slopes, in the Shallow Prairie range site.

Conservation Service or the Cooperative Extension Service or from a nursery.

Recreation

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

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

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

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

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

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

Wildlife Habitat

Billy M. Teels, biologist, Soil Conservation Service, helped prepare this section.

Garvin County soils provide habitat for sizable populations of the wildlife characteristic of central Oklahoma. The mixture of crops, range, forest, and pasture provide habitat diversity important to game such as dove, quail, turkey, deer, and squirrel and furbearers such as raccoon, fox, opossum, and beaver. Farm ponds, floodwater-retarding structures, and the Washita River provide good habitat for wintering waterfowl. Most farm ponds have been stocked with bass, catfish, and bluegill sunfish.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

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

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

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

Grasses and legumes are perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are plains bluestem, fescue, sericea lespedeza, lovegrass, vetch, clover, and alfalfa.

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

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, cottonwood, pecan, osageorange, blackhaw, persimmon, sumac, grape, plum, black locust, hawthorn, dogwood, hickory, blackberry, and hackberry.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, red cedar, and juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are roughleaf dogwood, coralberry, wild plum, and greenbrier. Fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

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

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

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

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

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, thrushes, woodpeckers, squirrels, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include coyote, deer, meadowlark, and bobwhite.

Engineering

Charles E. Bollinger, conservation engineer, and Jesse L. McMasters, civil engineer, Soil Conservation Service, helped prepare this section.

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

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

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

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

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

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

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

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

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

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

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

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

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

Sanitary Facilities

Table 12 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and that good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

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

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

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

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

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

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

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

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

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

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

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

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

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

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

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

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

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

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

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

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

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

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

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

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

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

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

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

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 20.

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

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

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

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

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

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*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 and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

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

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

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

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

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

Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

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

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

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

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

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

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

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

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

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

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

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

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

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

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

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

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

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

Flooding, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in sloughs and potholes.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs, on the average, no more than once in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. 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; March-October, for example, means that flooding can occur during the period March through October.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 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. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An *artesian* water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated.

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

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Physical and Chemical Analyses of Selected Soils

The results of physical analysis of several typical pedons in the survey area are given in table 18 and the results of chemical analysis in table 19. The data are for soils sampled at carefully selected sites. The pedons are typical of the series and are described in the section "Soil Series and Their Morphology." Soil samples were analyzed by the Soil Morphology, Genesis, and Classification Laboratory, Department of Agronomy, Oklahoma State University.

Most determinations, except those for grain-size analysis and bulk density, were made on soil material smaller than 2 millimeters in diameter. Measurements reported as percent or quantity of unit weight were calculated on an oven-dry basis. The methods used in obtaining the data are indicated in the list that follows. The codes in parentheses refer to published methods (*5*).

Sand—(0.05-2.0 mm fraction) weight percentages of materials less than 2 mm (3A1).
Silt—(0.002-0.05 mm fraction) pipette extraction, weight percentages of all materials less than 2 mm (3A1).
Clay—(fraction less than 0.002 mm) pipette extraction, weight percentages of materials less than 2 mm (3A1).
Organic matter—peroxide digestion (6A3).
Extractable cations—ammonium acetate pH 7.0, uncorrected; calcium (6N2), magnesium (6O2), sodium (6P2), potassium (6Q2).
Cation-exchange capacity—sum of cations (5A3a).
Base saturation—sum of cations, TEA, pH 8.2 (5C3).
Reaction (pH)—1:1 water dilution (8C1a).
Total phosphorus—perchloric acid; colorimetry (6S1a).

Engineering Index Test Data

Table 20 shows laboratory test data for two pedons sampled at carefully selected sites in the survey area. The samples were tested by the Oklahoma Department of Transportation, Materials Division.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM); Shrinkage—T 92 (AASHTO), D 427 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*6*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 21 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Fluvent (*Fluv*, meaning water deposit, plus *ent*, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Ustifluvent (*Usti*, meaning ustic moisture regime, plus *Fluvent*, the suborder of the Entisols that are deposits on flood plains).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Ustifluvent.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is coarse-loamy, mixed, calcareous, thermic Typic Ustifluvents.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*4*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*6*). Unless otherwise stated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Amber Series

The Amber series consists of deep, moderately permeable, very gently sloping, well drained soils on flood plains. These soils formed in loamy sediment under a cover of tall grasses and scattered hardwood trees. Slopes are 1 to 3 percent. The Amber series is a member of the coarse-silty, mixed, thermic family of Udic Ustochrepts.

The Amber soils are associated with Asher, Dale, Keokuk, Lela, and McLain soils. Asher and Dale soils are on slightly higher positions, and they have a mollic epipedon and a fine-silty control section. Keokuk soils are in slightly higher areas, and they have a mollic epipedon. Lela and McLain soils are in nearly level or slightly higher concave areas, and they have a fine control section and a mollic epipedon.

Typical pedon of Amber very fine sandy loam, 1 to 3 percent slopes, rarely flooded, 1,800 feet west and 300 feet south of the northeast corner of sec. 25, T. 4 N., R. 1 W.

A1—0 to 9 inches; reddish brown (5YR 5/4) very fine sandy loam, reddish brown (5YR 4/4) moist; weak fine granular structure; soft, very friable; many fine roots; mildly alkaline; gradual smooth boundary.

B2—9 to 42 inches; red (2.5YR 4/6) very fine sandy loam, dark red (2.5YR 3/6) moist; weak fine granular structure; slightly hard, very friable; many fine roots; common fine pores; mildly alkaline; gradual smooth boundary.

C—42 to 80 inches; red (2.5YR 5/6) very fine sandy loam, red (2.5YR 4/6) moist; massive; slightly hard, very friable; few fine roots, few fine pores; stratified with thin layers of silt loam; soft bodies and threads of calcium carbonate; calcareous; moderately alkaline.

Depth to bedrock is more than 60 inches. Depth to the water table is more than 6 feet. Depth to soft powdery lime is more than 40 inches.

The A horizon has hue of 5YR, value of 4 or 5, and chroma of 3 or 4. In some pedons, a moist A horizon has value and chroma of less than 3.5 but is less than 10 inches thick. Reaction is neutral to moderately alkaline.

The B2 horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. Texture is very fine sandy loam or silt loam. Reaction is neutral to moderately alkaline.

The C horizon has hue of 2.5YR or 5YR, value of 5, and chroma of 6. Texture is very fine sandy loam with thin strata of silt loam or loamy fine sand. The C horizon is moderately alkaline and calcareous.

Asa Series

The Asa series consists of well drained soils that formed in stratified loamy or silty alluvium on flood plains. Areas of these nearly level soils are smooth or slightly concave. Permeability is moderate. Slopes are less than 1 percent. The Asa series is a member of the fine-silty, mixed, thermic family of Fluventic Haplustolls.

Asa soils are associated with Bergstrom, Elandco, Gaddy, Garvin, Gracemont, Port, Pulaski, and Yahola soils. Bergstrom, Elandco, and Port soils have a mollic epipedon more than 20 inches thick and occur in similar areas. Gaddy soils have a sandy control section and are in lower areas, generally closer to the stream channel. Garvin soils have a fine control section and occur in areas similar to those of the Asa soils. Gracemont, Pulaski, and Yahola soils have a coarse-loamy control section and generally occur in areas similar to those of the Asa soils. In addition, Gracemont soils have a water table near the surface during winter and spring.

Typical pedon of Asa silty clay loam, occasionally flooded, 910 feet north and 225 feet east of the southwest corner of sec. 21, T. 1 N., R. 2 W.

A1—0 to 11 inches; brown (7.5YR 5/2) silty clay loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; slightly hard, friable; calcareous; moderately alkaline; gradual smooth boundary.

B21—11 to 16 inches; dark brown (7.5YR 4/4) silty clay loam, dark brown (7.5YR 4/3) moist; weak fine subangular blocky structure; slightly hard, friable; many fine roots; many fine pores; calcareous; moderately alkaline; clear smooth boundary.

B22—16 to 45 inches; reddish yellow (7.5YR 6/6) silty clay loam, strong brown (7.5YR 5/6) moist; weak fine subangular blocky structure; slightly hard, friable; many fine roots; common fine pores; organic stains in root channels; calcareous; moderately alkaline; clear smooth boundary.

Cca—45 to 72 inches; dark brown (7.5YR 4/4) silty clay loam, dark brown (7.5YR 3/4) moist; massive; hard, firm; few thin strata of loam and loamy fine sand; calcareous; moderately alkaline.

Thickness of the solum is 35 to 60 inches.

The A horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 2 or 3. Reaction ranges from neutral to moderately alkaline.

The B2 horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. Texture is silty clay loam or silt loam. Reaction is mildly alkaline or moderately alkaline.

The Cca horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. It is silty clay loam or clay loam with thin strata of very fine sandy loam, loam, or loamy fine sand.

Asher Series

The Asher series consists of deep, well drained, slowly permeable soils on nearly level to slightly convex flood plains of the Washita River. These soils formed in loamy alluvium under a cover of tall prairie grasses. Slopes are less than 1 percent. The Asher series is a member of the fine-silty, mixed, thermic family of Fluventic Haplustolls.

Asher soils are associated with the Amber, Dale, Keokuk, Lela, and McLain soils. Amber soils are on slightly lower side slopes, have no mollic epipedon, and have a coarse-silty control section. Dale soils are in areas similar to those of Asher soils and have a mollic epipedon more than 20 inches thick. Keokuk soils, in similar areas, have a coarse-silty control section. Lela and McLain soils are slightly lower and have a fine control section.

Typical pedon of Asher silty clay loam, rarely flooded, 2,250 feet west and 200 feet south of the northeast corner of sec. 13, T. 3 N., R. 1 W.

A1—0 to 16 inches; dark reddish brown (5YR 3/2) silty clay loam, dark reddish brown (5YR 2/2) moist; weak medium subangular blocky structure; hard, firm; many fine roots; many fine pores; mildly alkaline; gradual smooth boundary.

B2—16 to 38 inches; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; hard, firm; many fine roots, common fine pores; calcareous; few threads of calcium carbonate in lower part; mildly alkaline; gradual smooth boundary.

IIC—38 to 80 inches; yellowish red (5YR 5/8) silt loam, yellowish red (5YR 4/6) moist; massive; slightly hard, very friable; few fine roots; common thin strata of loam and silty clay loam; few soft bodies and threads of calcium carbonates; calcareous; moderately alkaline.

Solum thickness ranges from 20 to 38 inches. Depth to secondary carbonates ranges from 12 to 32 inches, and depth to the coarse-silty texture ranges from 20 to 38 inches. Depth to the water table is more than 6 feet. Some pedons have buried horizons below a depth of 50 inches.

The A horizon has hue of 5YR or 7.5YR, value of 3 or 4, and chroma of 2 or 3. Reaction is neutral to moderately alkaline.

The B2 horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 6. Reaction is neutral to moderately alkaline.

The IIC horizon has hue of 2.5YR or 5YR, value of 5 to 7, and chroma of 2 to 8. Texture is stratified silt loam, loam, or silty clay loam.

Bergstrom Series

The Bergstrom series consists of deep, well drained, moderately permeable, nearly level soils on flood plains. These soils formed in loamy alluvium under a cover of tall prairie grasses. Slopes are 0 to 1 percent. The Bergstrom series is a member of the fine-silty, mixed, thermic family of Cumulic Haplustolls.

Bergstrom soils are associated with Asa, Elandco, Gaddy, Garvin, Gracemont, Port, Pulaski, and Yahola soils. Asa, Elandco, and Port soils occur in areas similar to those of the Bergstrom soils. Asa soils have a mollic epipedon less than 20 inches thick, Elandco soils have hue of 10YR or yellower in the control section, and Port soils are not calcareous throughout the control section. Gaddy soils have a sandy control section and are in lower areas, usually closer to the stream channel. Garvin soils have a fine control section and occur in areas similar to those of the Bergstrom soils. Gracemont, Pulaski, and Yahola soils have a coarse-loamy control section and usually occur in areas similar to those of the Bergstrom soils. In addition, Gracemont soils have a water table near the surface during the winter and spring.

Typical pedon of Bergstrom silt loam, occasionally flooded, 800 feet north and 3,400 feet east of the southwest corner of sec. 27, T. 1 N., R. 1 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, very friable; few fine roots; calcareous; moderately alkaline; clear smooth boundary.

A1—8 to 22 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate coarse granular structure; slightly hard, friable; few fine roots; few fine pores; calcareous; moderately alkaline; gradual smooth boundary.

B2—22 to 71 inches; brown (7.5YR 5/2) silty clay loam, dark brown (7.5YR 4/2) moist; moderate fine and medium subangular blocky structure; hard, firm; few fine roots; few fine pores; common fine bodies and films of calcium carbonates; calcareous; moderately alkaline; gradual smooth boundary.

C—71 to 80 inches; reddish brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; massive; hard, firm; few thin strata of dark reddish brown silty clay loam; common fine bodies and films of calcium carbonates; calcareous; moderately alkaline.

Depth to bedrock is more than 60 inches. Depth to the water table is more than 6 feet.

The A horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 2 or 3. It is moderately alkaline and calcareous.

The B2 horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 2 to 4. Texture is silt loam, silty clay loam, or clay loam. The B2 horizon is moderately alkaline and calcareous.

The C horizon has color and texture similar to those of the B horizon. Thin strata of coarser or finer texture occur below 40 inches. The C horizon is moderately alkaline and calcareous.

Bethany Series

The Bethany series consists of deep, well drained, slowly permeable, nearly level to very gently sloping soils on broad smooth ridgetops of uplands. These soils formed in material weathered from alluvium under a cover of tall prairie grasses. Slopes range from 0 to 3 percent. The Bethany series is a member of the fine, mixed, thermic family of Pachic Paleustolls.

Bethany soils are associated with the Grainola, Loco, Lucien, Nash, Renfrow, and Zaneis soils. Grainola soils have no mollic epipedon, have a solum 20 to 40 inches thick, and occur on lower side slopes. Loco and Lucien soils have a solum 10 to 20 inches thick and occur in lower areas. Nash soils have no argillic horizon and occur on side slopes. Renfrow soils have a mollic epipedon less than 20 inches thick and occur in slightly more convex areas. Zaneis soils have a mollic epipedon less than 20 inches thick, have a solum 40 to 60 inches thick, have a fine-loamy control section, and occur on slightly lower side slopes.

Typical pedon of Bethany silt loam, 1 to 3 percent slopes, 1,000 feet south and 100 feet east of the northwest corner of sec. 1, T. 2 N., R. 1 W.

A1—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; many fine roots; common fine pores; slightly acid; gradual smooth boundary.

B1—10 to 20 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; hard, firm; many fine roots; common fine pores; slightly acid; gradual smooth boundary.

B21t—20 to 42 inches; brown (10YR 5/3) clay, dark brown (10YR 3/3) moist; common fine distinct reddish brown (5YR 5/3) mottles; moderate medium blocky structure; very hard, very firm; common fine roots; common fine pores; few fine black concretions; clay films on faces of peds; neutral; gradual smooth boundary.

B22t—42 to 50 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; moderate coarse blocky structure; very hard, very firm; few fine roots; few fine pores; few fine black concretions; clay films on faces of peds; mildly alkaline; gradual smooth boundary.

B23t—50 to 63 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; common coarse distinct brownish yellow (10YR 6/6) and light yellowish brown (10YR 6/4) mottles; moderate medium and coarse blocky structure; very hard, very firm; few fine black concretions; clay films on faces of peds; few fine calcium carbonate concretions; moderately alkaline; gradual smooth boundary.

B3—63 to 81 inches; reddish yellow (5YR 6/6) silty clay loam, yellowish red (5YR 5/6) moist; common coarse distinct very pale brown (10YR 7/3) mottles; weak coarse blocky structure; hard, firm; moderately alkaline.

Depth to bedrock is more than 60 inches.

The A1 horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 or 3. Reaction is medium acid to neutral.

The B1 horizon is similar to the A horizon in color. Texture is clay loam or silty clay loam. Reaction is slightly acid or neutral.

The B21t horizon or B22t horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 6. Texture is clay or silty clay and reaction is neutral to moderately alkaline.

The B23t horizon has hue of 5YR to 10YR, value of 4 to 6, and chroma of 3 to 6. Mottles are in shades of red, brown, or yellow. Texture is clay or silty clay, and reaction is mildly alkaline or moderately alkaline.

The B3 horizon is similar to the B23t horizon in color and reaction. Texture is clay, silty clay loam, or clay loam.

Burleson Series

The Burleson series consists of deep, moderately well drained, very slowly permeable, very gently sloping soils on smooth broad uplands. These soils formed in clayey sediments under a cover of tall prairie grasses. Slopes are 1 to 3 percent. The Burleson series is a member of the fine, montmorillonitic, thermic family of the Udic Pellusterts.

Burleson soils are associated with Chigley, Clarita, Durant, Rayford, Tussy, and Wilson soils. Chigley, Durant, and Wilson soils have an argillic horizon, and they occur in slightly lower areas. Clarita soils have hue of 7.5YR or redder in the AC horizon and occur on slightly lower side slopes. Rayford soils have a solum 8 to 20 inches thick overlying hard limestone conglomerate, have a loamy-skeletal control section, and occur on lower side slopes. Tussy soils have a solum 20 to 40 inches thick and occur on lower side slopes.

Typical pedon of Burleson clay, 1 to 3 percent slopes, 1,200 feet south and 200 feet east of the northwest corner of sec. 2, T. 3 N., R. 3 E.

A11—0 to 20 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; gray (10YR 5/1) hard surface crust about 1/8 inch thick; weak coarse blocky structure parting to moderate fine blocky; extremely hard, very firm; many fine roots; common fine pores; shiny pressure faces on peds; slightly acid; diffuse wavy boundary.

A12—20 to 35 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; intersecting slickensides; moderate fine and medium blocky structure; extremely hard, very firm, common fine roots; common fine pores; shiny pressure faces on peds; few very dark brown strongly cemented concretions 1 to 3 millimeters in diameter; slightly acid; diffuse wavy boundary.

AC1—35 to 52 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; few coarse distinct light olive gray (5Y 6/2) mottles; extremely hard, very firm; few fine roots; distinct intersecting grooved slickensides; shiny pressure faces on peds; few very dark brown strongly cemented concretions 1 to 3 millimeters in diameter; few streaks of very dark gray clay in cracks; few fine strongly cemented calcium carbonate concretions; mildly alkaline; diffuse wavy boundary.

AC2—52 to 66 inches; coarsely mottled light olive gray (5Y 6/2) and pale olive (5Y 6/4) clay, olive gray (5Y 5/2) and olive (5Y 5/4) moist; extremely hard, very firm; few fine dark brown strongly cemented concretions; few fine strongly cemented calcium carbonate concretions; few soft bodies of calcium carbonate; calcareous; moderately alkaline.

Depth to bedrock is more than 60 inches. When the soil is dry, it has cracks ranging from 0.4 to 1.5 inches in width at a depth of 20 inches. Intersecting slickensides begin at depths of 20 to 30 inches. Thickness of the A horizon ranges from 12 inches on the microknolls to as much as 40 inches in the microdepressions.

The A horizon has hue of 10YR, value of 3 to 5, and chroma of 1. Reaction ranges from medium acid to moderately alkaline.

The AC horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 4. It has few to common, faint to distinct mottles of brown, gray, olive, and yellow. In most pedons, old cracks in the AC horizon are filled with material similar to that in the A1 horizon, but darker. The AC horizon ranges from mildly to moderately alkaline and from noncalcareous to calcareous.

Chigley Series

The Chigley series consists of deep, moderately well drained, moderately slowly permeable soils. These very gently sloping to strongly sloping soils are on side slopes and ridgetops of uplands. They formed in cherty conglomerate under a cover of savannah trees. Slopes range from 1 to 12 percent. The Chigley series is a member of the fine, mixed, thermic family of Udic Paleustalfs.

Chigley soils are associated with Burleson, Clarita, Durant, Rayford, Tussy, and Wilson soils. Burleson and Clarita soils have no argillic horizon. Burleson soils occur on slightly higher flats, and Clarita soils occur in areas similar to those of the Chigley soils. Durant soils have a mollic epipedon and occur on slightly higher flats and side slopes. Rayford soils have a loamy-skeletal control section, have a solum 10 to 20 inches thick over hard cherty conglomerate, and are slightly lower than the Chigley soils. Tussy soils have no argillic horizon, have a solum 20 to 40 inches thick, and occur in areas similar to those of the Chigley soils. Wilson soils have a perched water table in winter and spring and occur in concave areas.

Typical pedon of Chigley gravelly sandy loam, 1 to 5 percent slopes, about 2,640 feet south and 60 feet west of the northeast corner of sec. 2, T. 3 N., R. 2 E.

A1—0 to 4 inches; brown (10YR 5/3) gravelly sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, very friable; many medium and fine roots; coarse fragments of chert less than 3 inches in diameter make up 20 percent by volume; neutral; clear wavy boundary.

A2—4 to 6 inches; brown (7.5YR 5/4) gravelly sandy loam, dark brown (7.5YR 4/4) moist; weak fine granular structure; slightly hard, very friable; many medium and fine roots; coarse fragments of chert less than 3 inches in diameter make up 20 percent by volume; neutral; clear wavy boundary.

B21t—6 to 18 inches; reddish yellow (5YR 6/6) gravelly clay, yellowish red (5YR 5/6) moist; moderate medium blocky structure; very hard, very firm; many medium and fine roots; many fine pores; clay films on faces of peds; coarse fragments of chert less than 3 inches in diameter make up 15 percent by volume; medium acid; gradual smooth boundary.

B22t—18 to 42 inches; red (2.5YR 5/8) gravelly clay, red (2.5YR 4/8) moist; common medium distinct yellowish brown (10YR 5/4) mottles; moderate coarse blocky structure; very hard, very firm; common medium and fine roots; common fine pores; clay films on faces of peds; few nonintersecting slickensides; coarse fragments of chert less than 3 inches in diameter make up 15 percent by volume; medium acid; gradual smooth boundary.

B3—42 to 54 inches; reddish yellow (7.5YR 6/6) clay, strong brown (7.5YR 5/6) moist; many fine and medium distinct pale brown (10YR 6/3) mottles; weak coarse blocky structure; very hard, very firm; few fine roots; few pores; coarse fragments of chert less than 3 inches in diameter make up 5 percent by volume; slightly acid; gradual smooth boundary.

C—54 to 64 inches; light yellowish brown (10YR 6/4) gravelly clay, yellowish brown (10YR 5/4) moist; few medium prominent red (2.5YR 5/8) mottles; massive; very hard, very firm; many dark streaks; coarse fragments of chert less than 3 inches in diameter make up 20 percent by volume; neutral.

Depth to bedrock is more than 60 inches.

The A1 horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. Texture is gravelly loam or gravelly sandy loam. Content of coarse fragments of chert less than 3 inches in diameter ranges from 15 to 30 percent by volume. Reaction is medium acid to neutral.

The A2 horizon has hue of 7.5YR or 10YR, value of 4 to 7, and chroma of 3 or 4. Texture and content of coarse fragments are the same as in the A1 horizon. Reaction is strongly acid to neutral.

The B21t horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 4 to 8. It is mottled in shades of red or brown in some pedons. Texture is sandy clay, clay, or clay loam or their gravelly counterparts. Coarse fragments of chert less than 3 inches in diameter make up 5 to 30 percent of the volume. Reaction ranges from strongly acid to slightly acid.

The B22t horizon has the same color, mottles, texture, and content of coarse fragments as the B21t horizon. Reaction is medium acid to neutral.

The B3 horizon has hue of 5YR to 10YR, value of 5 or 6, and chroma of 4 to 8 or is coarsely mottled in shades of brown, red, yellow, or gray. Texture is clay, sandy clay, clay loam, sandy clay loam, or their gravelly counterparts. Content of coarse fragments of chert is the same as in the B21t horizon. Reaction ranges from slightly acid to moderately alkaline.

The C horizon has colors similar to those in the B3 horizon. Texture is gravelly sandy clay, gravelly clay loam, gravelly sandy clay loam, or gravelly clay. Coarse fragments of chert less than 3 inches in diameter make up 20 to 30 percent of the volume. Reaction ranges from neutral to moderately alkaline.

Clarita Series

The Clarita series consists of deep, moderately well drained, very slowly permeable soils that formed in clay. These very gently sloping to strongly sloping soils are on slightly convex side slopes on uplands. Slopes range from 2 to 12 percent. The soils of the Clarita series are fine, montmorillonitic, thermic Udic Pellusterts.

Clarita soils are associated with Burleson, Chigley, Durant, Rayford, Tussy, and Wilson soils. Burleson soils are on broad ridgetops that are slightly higher than the Clarita soils and have hue of 10YR or yellower in the AC horizon. Chigley, Durant, and Wilson soils have an argillic horizon and occur in areas similar to those of the Clarita soils. Rayford soils have a loamy-skeletal control section, have a solum 10 to 20 inches thick over hard limestone conglomerate, and occur on slightly lower side slopes. Tussy soils have a solum 20 to 40 inches thick and are slightly lower than the Clarita soils.

Typical pedon of Clarita clay, 2 to 5 percent slopes, 1,320 feet west and 100 feet south of the northeast corner of sec. 2, T. 2 N., R. 3 E.

A1—0 to 25 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; strong medium granular structure; very hard, very firm; many fine roots; few pores; few intersecting slickensides in lower part; few coarse fragments of chert and limestone less than 3 inches in diameter; moderately alkaline; gradual wavy boundary.

AC—25 to 45 inches; brown (7.5YR 5/2) clay, dark brown (7.5YR 4/2) moist; weak medium blocky structure; extremely hard, very firm; few fine roots; few intersecting slickensides; many pressure faces on peds; few bodies and coatings of very dark gray (10YR 3/1) on faces of peds; few coarse fragments of chert and limestone less than 3 inches in diameter; soft bodies and concretions of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

C—45 to 80 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; massive; extremely firm; few slickensides; common soft bodies and concretions of calcium carbonate; calcareous; moderately alkaline.

Depth to bedrock is more than 60 inches. Solum thickness ranges from 35 to 65 inches. The A horizon is 2 to 35 inches thick. It is thinnest in the microhighs and thickest in the microlows. The distances between the center of the microhighs and the center of the microlows range from 5 to 12 feet.

The A horizon has hue of 10YR, value of 2 to 4, and chroma of 1 to 3. Reaction is mildly alkaline or moderately alkaline.

The AC horizon has hue of 2.5YR to 7.5YR, value of 4 to 5, and chroma of 2 to 6. Texture is clay or silty clay.

The C horizon has hue of 2.5YR or 5YR, value of 3 to 5, and chroma of 3 to 8.

The Clarita soils in map units 11, 13, and 14 are taxadjuncts to the Clarita series because they have chroma of 2 or 3 in the A horizon in more than 50 percent of the pedon. This difference has little effect on their behavior, use, and management.

Dale Series

The Dale series consists of deep, well drained, moderately permeable soils that formed in alluvial sediments. These nearly level soils are on rarely flooded, broad, smooth flood plains of the Washita River. Slopes range from 0 to 1 percent. The Dale series is a member of fine-silty, mixed, thermic family of Pachic Haplustolls.

Dale soils are associated with the Amber, Asher, Keokuk, Lela, and McLain soils. Amber soils, on side slopes, have no mollic epipedon and have a coarse-silty control section. Asher soils, which are in areas similar to those of the Dale soils, have a mollic epipedon less than 20 inches thick. Keokuk soils are in similar areas, have a mollic epipedon less than 20 inches thick, and have a coarse-silty control section. Lela and McLain soils are in slighty lower areas than the Dale soils and have a fine control section.

Typical pedon of Dale silt loam, rarely flooded, 1,660 feet east and 100 feet south of the northwest corner of sec. 16, T. 3 N., R. 1 E.

Ap—0 to 9 inches; dark brown (7.5YR 4/2) silt loam, dark brown (7.5YR 3/2) moist; weak fine and medium granular structure; slightly hard, friable; many fine roots; neutral; clear smooth boundary.

A1—9 to 22 inches; reddish brown (5YR 4/3) silt loam, dark reddish brown (5YR 3/3) moist; moderate fine and medium granular structure; hard, friable; many fine roots; common pores; neutral; gradual smooth boundary.

B2—22 to 36 inches; yellowish red (5YR 5/6) silt loam, yellowish red (5YR 4/6) moist; weak coarse prismatic structure; hard, friable; few fine roots; few pores; mildly alkaline; gradual smooth boundary.

C—36 to 72 inches; red (2.5YR 5/6) silt loam, red (2.5YR 4/6) moist; massive; hard, friable; few fine roots; few pores; few soft bodies, concretions, and films of calcium carbonates; calcareous; moderately alkaline.

Depth to bedrock is more than 60 inches. Depth to the water table is more than 6 feet.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. Reaction is slightly acid to mildly alkaline.

The B2 horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 4 to 8. Texture is silt loam, silty clay loam, or loam. Reaction is neutral to moderately alkaline.

The C horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 8. Texture is silt loam or loam. A few pedons have coarser and finer textures below 50 inches. Reaction is neutral to moderately alkaline.

Darnell Series

The Darnell series consists of shallow, well drained to somewhat excessively drained, moderately rapidly permeable soils. These sloping to moderately steep soils are on ridge crests and upper side slopes of uplands. They formed in material weathered from sandstone under a cover of trees with an understory of native grasses. Slopes range from 5 to 20 percent. The Darnell series is a member of the loamy, siliceous, thermic, shallow family of Udic Ustochrepts.

Darnell soils are associated with Konsil, Newalla, and Stephenville soils. Konsil, Newalla, and Stephenville soils have a solum more than 20 inches thick and have an argillic horizon. Konsil and Stephenville soils generally occur on side slopes. Newalla soils occur on similar landscapes as Darnell soils and have a fine-loamy over clayey control section.

Typical pedon of Darnell fine sandy loam in an area of Stephenville-Darnell complex, 5 to 20 percent slopes, 2,800 feet north and 950 feet east of the southwest corner of sec. 6, T. 3 N., R. 4 W.

A1—0 to 4 inches; brown (10YR 5/3) fine sandy loam, brown (10YR 4/3) moist; weak fine granular structure; slightly hard, very friable; many fine roots; few coarse fragments of sandstone less than 3 inches in diameter; medium acid; clear smooth boundary.

B2—4 to 10 inches; very pale brown (10YR 7/3) fine sandy loam, pale brown (10YR 6/3) moist; weak fine granular structure; slightly hard, very friable; many fine roots; few coarse fragments of sandstone less than 3 inches in diameter; medium acid; clear wavy boundary.

Cr—10 to 15 inches; red (2.5YR 5/6) weakly cemented sandstone; slightly acid.

Thickness of the solum and depth to sandstone bedrock range from 10 to 20 inches.

The A horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 2 to 4. Reaction ranges from strongly acid to slightly acid.

The B horizon has hue of 5YR to 10YR, value of 4 to 7, and chroma of 2 to 6. Reaction ranges from strongly acid to neutral.

The Cr horizon is red, reddish yellow, or yellowish red weakly cemented sandstone.

Durant Series

The Durant series consists of deep, moderately well drained, very slowly permeable soils that formed in predominantly alkaline clays under a cover of tall prairie grasses. These nearly level to gently sloping soils are on broad, smooth uplands. Slopes range from 0 to 5 percent. The Durant series is a member of the fine, montmorillonitic, thermic family of Vertic Argiustolls.

Durant soils are associated with the Burleson, Chigley, Clarita, Rayford, Tussy, and Wilson soils. Burleson and Clarita soils have no argillic horizon. The Burleson soils occur on slightly higher broad flats, whereas the Clarita soils occur on slightly lower side slopes. Chigley and Wilson soils have no mollic epipedon, and the Chigley soils occur on slightly lower side slopes, whereas the Wilson soils occur in slightly concave areas. Rayford soils have a loamy-skeletal control section, have a solum 8 to 20 inches thick over hard limestone conglomerate, and occur on lower side slopes. Tussy soils do not have a mollic epipedon or an argillic horizon and occur on lower side slopes.

Typical pedon of Durant loam, 1 to 3 percent slopes, 650 feet west and 1,300 feet south of the northeast corner of sec. 28, T. 4 N., R. 3 E.

A1—0 to 10 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; many fine roots; slightly acid; gradual smooth boundary.

B1—10 to 14 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; hard, firm; many fine roots; common pores; slightly acid; gradual smooth boundary.

B21t—14 to 38 inches; dark brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; common medium distinct reddish brown (5YR 4/3) mottles; weak medium blocky structure; very hard, very firm; few fine roots; few pores; few fine black concretions; few vertical cracks filled with dark grayish brown (10YR 4/2) silty clay loam; clay films on faces of peds; slightly acid; gradual smooth boundary.

B22t—38 to 48 inches; yellowish brown (10YR 5/4) clay, dark yellowish brown (10YR 4/4) moist; few fine faint brownish yellow mottles; weak coarse blocky structure; very hard, very firm; few fine roots; few pores; clay films on faces of peds; few soft bodies and concretions of calcium carbonate; mildly alkaline; gradual smooth boundary.

B3—48 to 60 inches; brown (7.5YR 5/4) clay, dark brown (7.5YR 4/4) moist; few fine faint reddish brown mottles; weak coarse blocky structure; extremely hard, extremely firm; few calcium carbonate concretions; mildly alkaline.

Depth to bedrock is more than 60 inches. Solum thickness ranges from 46 to more than 60 inches.

The A1 horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 or 3. It is loam or clay loam. Reaction is medium acid or slightly acid.

The B1 horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. Texture is clay, clay loam, or silty clay loam. Reaction is medium acid to neutral.

The B2t horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 6. The B2t horizon has mottles in shades of red, brown, gray, or yellow in most pedons. Reaction ranges from medium acid to moderately alkaline.

The B3 horizon has hue of 7.5YR to 2.5Y, value of 4 to 7, and chroma of 2 to 6. It has mottles in shades of red, brown, yellow, or gray. Reaction ranges from slightly acid to moderately alkaline.

The Durant soils in map units 19 and 20 are taxadjuncts to the Durant series because they do not have mollic colors deep enough to be a mollic epipedon. This difference does not affect use, management, and behavior.

Elandco Series

The Elandco series consists of deep, well drained, moderately permeable, nearly level soils on flood plains. These soils formed in loamy alluvium under a cover of tall prairie grasses. Slopes are 0 to 1 percent. The Elandco series is a member of the fine-silty, mixed, thermic family of Cumulic Haplustolls.

Elandco soils are associated with Asa, Bergstrom, Gaddy, Garvin, Gracemont, Port, Pulaski, and Yahola soils. Asa soils have a mollic epipedon less than 20 inches thick and occur in slightly higher areas than the Elandco soils. Bergstrom soils are calcareous throughout the control section and occur in slightly higher areas. Gaddy soils do not have a mollic epipedon, have a sandy control section, and occur in lower areas closer to the stream channel. Garvin soils have a fine control section and occur in areas similar to those of the Elandco soils. Gracemont, Pulaski, and Yahola soils do not have a mollic epipedon, have a coarse-loamy control section, and occur in areas similar to those of the Elandco soils. In addition, Gracemont soils have a water table near the surface during the winter and spring. Port soils have hue of 7.5YR or redder in the control section and are in areas similar to those of the Elandco soils.

Typical pedon of Elandco silty clay loam, occasionally flooded, 650 feet south and 350 feet west of the northeast corner of sec. 25, T. 3 N., R. 3 E.

A11—0 to 15 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; common fine and medium roots; mildly alkaline; gradual smooth boundary.

A12—15 to 32 inches; dark brown (10YR 4/3) silty clay loam, dark brown (10YR 3/3) moist; moderate coarse granular structure; hard, firm; common fine roots; common fine and medium pores; mildly alkaline; gradual smooth boundary.

A13—32 to 48 inches; dark brown (10YR 4/3) silty clay loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; hard, firm; few soft bodies of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

C—48 to 60 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; massive; hard, firm; few calcium carbonate concretions; calcareous; moderately alkaline.

Depth to bedrock is more than 60 inches. Depth to the water table is more than 6 feet. Depth of secondary carbonates ranges from 20 to 60 inches.

The A horizon has hue of 10YR, value of 3 to 5, and chroma of 2 or 3. Texture of the A12 horizon and A13 horizon is clay loam, silt loam, or silty clay loam. Reaction of the A11 horizon and A12 horizon ranges from slightly acid to mildly alkaline. Reaction of the A13 horizon is mildly alkaline or moderately alkaline.

The C horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. Its texture is the same as the A horizon. In some pedons, thin strata of coarser or finer texture are below 35 inches.

Gaddy Series

The Gaddy series consists of deep, somewhat excessively drained, nearly level soils on flood plains of the Washita River. These soils have moderately rapid to rapid permeability. They formed in sandy calcareous sediments under a cover of tall and mid grasses and hardwood trees. Slopes range from 0 to 1 percent. The Gaddy series is a member of the sandy, mixed, thermic family of Typic Ustifluvents.

The Gaddy soils are associated with Asa, Bergstrom, Elandco, Garvin, Gracemont, Port, Pulaski, and Yahola soils. Asa, Bergstrom, Elandco, and Port soils occur on slightly higher landscapes, have a mollic epipedon, and have a fine-silty control section. Garvin soils occur on slightly higher landscapes, have a fine control section, and have a mollic epipedon. Gracemont, Pulaski, and Yahola soils have a coarse-loamy control section. Gracemont and Pulaski soils generally occur on slightly higher landscapes. Yahola soils generally occur on slightly lower concave landscapes. In addition, Gracemont soils have a water table above 40 inches during the winter and spring.

Typical pedon of Gaddy loamy fine sand, in an area of Yahola-Gaddy complex, frequently flooded, 5,100 feet south and 2,100 feet west of the northeast corner of sec. 25, T. 4 N., R. 1 W.

A—0 to 10 inches; brown (7.5YR 5/4) loamy fine sand, dark brown (7.5YR 4/4) moist; weak fine granular structure; slightly hard, friable; many fine roots; calcareous; moderately alkaline; gradual smooth boundary.

C—10 to 60 inches; reddish yellow (7.5YR 6/6) loamy fine sand, strong brown (7.5YR 5/6) moist; massive; soft, very friable; common thin strata of reddish brown (5YR 5/3) fine sandy loam; calcareous; moderately alkaline.

Depth to bedrock is more than 60 inches.

The A horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 4 to 6. Texture is loamy fine sand or fine sandy loam.

The C horizon has hue of 7.5YR, value of 6 to 8, and chroma of 4 to 6. Its texture is loamy fine sand or fine sand with thin strata of finer or coarser material.

Galey Series

The Galey series consists of deep, moderately well drained, moderately permeable, very gently sloping soils on broad ridgetops of uplands. These soils formed in sandy and loamy sediments under a cover of savannah trees. Slopes are 1 to 3 percent. The Galey series is a member of the fine-loamy, mixed, thermic family of Ultic Paleustalfs.

Galey soils are associated with Konawa and Justin soils. In Konawa soils, which are on adjacent side slopes, the clay content decreases by more than 20 percent in the lower part of the control section. Justin soils are on slightly higher positions and have a mollic epipedon.

Typical pedon of Galey loamy fine sand, 1 to 3 percent slopes, 100 feet north and 2,040 feet east of the southwest corner of sec. 1, T. 4 N., R. 3 E.

A1—0 to 8 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; many fine and medium roots; slightly acid; clear smooth boundary.

A2—8 to 12 inches; light brownish gray (10YR 6/2) loamy fine sand, grayish brown (10YR 5/2) moist; weak fine granular structure; soft, very friable; many fine and medium roots; slightly acid; clear smooth boundary.

B21t—12 to 31 inches; brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; moderate coarse prismatic structure; hard, firm; common fine and medium roots; many pores; few black concretions; clay films on faces of peds; medium acid; gradual smooth boundary.

B22t—31 to 45 inches; strong brown (7.5YR 5/6) sandy clay loam, strong brown (7.5YR 4/6) moist; many medium and coarse distinct pale brown (10YR 6/3) and light brownish gray (10YR 6/2) mottles; moderate medium and coarse subangular blocky structure; hard, firm; common fine roots; common pores; clay films on faces of peds; medium acid; gradual smooth boundary.

B3—45 to 60 inches; reddish yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 5/6) moist; many medium prominent pale brown (10YR 6/3), red (2.5YR 5/6), and gray (10YR 5/1) mottles; weak coarse subangular blocky structure; hard, firm; few fine roots; common pores; patchy clay films on faces of peds; neutral.

Depth to bedrock is more than 72 inches. The combined thickness of the A1 and A2 horizons is 10 to 20 inches.

The A1 horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 or 3. Reaction is medium acid or slightly acid.

The A2 horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 2 to 4. Reaction is medium acid or slightly acid. In some pedons, there is no A2 horizon.

The B2t horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 4 to 8. Mottles are in shades of red, gray, or brown in the lower part of the B2t horizon. Reaction is strongly acid or medium acid.

The B3 horizon has color similar to that in the B2t horizon. Mottles are in shades of red, gray, or brown. Texture is sandy clay loam or fine sandy loam. Reaction ranges from strongly acid to neutral.

Garvin Series

The Garvin series consists of deep, moderately well drained, very slowly permeable soils that formed in predominantly alkaline clayey alluvium under a cover of prairie grasses. These nearly level soils are on narrow to broad flood plains. Slopes are 0 to 1 percent. The Garvin series is a member of the fine, montmorillonitic, thermic family of Vertic Haplustolls.

Garvin soils are associated with the Asa, Bergstrom, Elandco, Gaddy, Gracemont, Port, Pulaski, Yahola soils. Asa, Bergstrom, Elandco, and Port soils have a fine-silty control section and occur in areas similar to those of the Garvin soils. Gaddy soils do not have a mollic epipedon, have a sandy control section, and occur in lower areas than the Garvin soils. Gracemont, Pulaski, and Yahola soils do not have a mollic epipedon, have a coarse-loamy control section, and occur in areas similar to those of the Garvin soils. In addition, Gracemont soils have a water table near the surface during the winter and spring.

Typical pedon of Garvin silty clay loam, occasionally flooded, 760 feet south and 2,395 feet west of the northeast corner of sec. 16, T. 3 N., R. 3 E.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak medium granular structure; very hard, very firm; many fine roots; few fine and medium pores; less than 1 percent exchangeable sodium; neutral; clear smooth boundary.

A1—9 to 32 inches; black (10YR 2/1) silty clay, black (10YR 2/1) moist; moderate fine subangular blocky structure; very hard, very firm; common fine roots; few fine and medium pores; shiny pressure faces below 20 inches; 4 percent exchangeable sodium; few fine calcium carbonate concretions; few films of calcium carbonate; neutral; gradual wavy boundary.

B2—32 to 65 inches; reddish brown (5YR 5/3) clay loam, reddish brown (5YR 4/3) moist; weak medium blocky structure; very hard, very firm; few fine roots; few fine pores; shiny pressure faces on faces of peds; few slickensides that do not intersect; common vertical cracks filled with black (10YR 2/1) silty clay: 28 percent exchangeable sodium; 5 percent by volume fine soft bodies and concretions of calcium carbonate; calcareous; strongly alkaline; gradual smooth boundary.

C—65 to 74 inches; dark reddish gray (5YR 4/2) clay, dark reddish brown (5YR 3/2) moist; massive; very hard, very firm; few fine roots; few fine pores; 27 percent exchangeable sodium; 5 percent by volume fine and medium soft bodies and concretions of calcium carbonate; calcareous; moderately alkaline.

Solum thickness is 30 to more than 60 inches. These soils have soft powdery lime within 30 inches of the soil surface. Cracks more than 1 centimeter wide extend from the surface to a depth of about 40 inches during some season in most years. Slickensides range from few to common but do not intersect. Clay content of the 10- to 40-inch control section ranges from 35 to 60 percent.

The Ap and A1 horizons have hue of 10YR, value of 2 to 4, and chroma of 1 or 2. They are clay, silty clay, clay loam, or silty clay loam. Exchangeable sodium ranges from 0 to 5 percent. Reaction is neutral to moderately alkaline in the A horizon and moderately alkaline to strongly alkaline in the B horizon. The combined thickness of the A1 and A2 horizons ranges from 20 to 40 inches.

The B2 horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 to 6. It is clay, silty clay, clay loam, or silty clay loam, and coefficient of linear extensibility exceeds 0.07. Clay content ranges from 35 to 60 percent. Vertic cracks are filled with material similar to that in the A horizon. Exchangeable sodium ranges from 10 to 30 percent.

The C horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 to 6. It has texture and clay content similar to those in the B2 horizon. Exchangeable sodium ranges from 10 to 30 percent. Some pedons have vertical cracks filled with material similar to that in the A horizon.

Gracemont Series

The Gracemont series consists of deep, somewhat poorly drained, moderately permeable soils with a high water table. These nearly level soils are on narrow to broad flood plains. They formed in loamy and sandy alluvium under a cover of tall grasses with a few tamarisk, eastern cottonwood, and other water-tolerant shrubs. Slopes range from 0 to 1 percent. The Gracemont series is a member of the coarse-loamy, mixed (calcareous), thermic family of Aquic Udifluvents.

Gracemont soils are associated with the Asa, Bergstrom, Elandco, Gaddy, Garvin, Port, Pulaski, and Yahola soils. Asa, Bergstrom, Elandco, and Port soils have a mollic epipedon, have a fine-silty control section, do not have a water table near the surface, and occur in areas similar to those of the Gracemont soils. Gaddy soils have a sandy control section and occur in lower areas. Garvin soils have a mollic epipedon, have a fine control section, do not have a water table near the surface, and occur in areas similar to those of the Gracemont soils. Pulaski and Yahola soils do not have a water table near the surface during the winter and spring and occur in slightly higher areas.

Typical pedon of Gracemont fine sandy loam, occasionally flooded, 3,600 feet south and 900 feet east of the northwest corner of sec. 11, T. 3 N., R. 3 W.

A1—0 to 7 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; moderate fine granular structure; slightly hard, very friable; many fine roots; many pores; calcareous; mildly alkaline; gradual smooth boundary.

C1—7 to 29 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) moist; massive; slightly hard, very friable; few fine roots; few pores; common thin strata of loamy fine sand and fine sand; calcareous; moderately alkaline; clear smooth boundary.

C2—29 to 47 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; few fine faint yellowish red mottles; massive; slightly hard, very friable; few fine roots; few thin strata of loam and loamy fine sand; water table at 34 inches; organic stains in root channels; calcareous; moderately alkaline; clear smooth boundary.

Ab—47 to 70 inches; reddish brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; few faint yellowish red mottles; massive; hard, firm; few thin strata of fine sandy loam and fine sand; calcareous; moderately alkaline.

Depth to bedrock is more than 60 inches. Depth to the water table ranges from 12 to 36 inches during November to May in most years.

The A horizon has hue of 5YR or 7.5YR, value of 3 to 6 when dry and 3 to 5 when moist, and chroma of 3 to 6 when moist or dry. In some pedons, the upper 10 inches of the soil is leached of lime and is neutral or mildly alkaline.

The C horizon has hue of 5YR or 7.5YR, value of 4 to 6 when dry and 3 to 5 when moist, and chroma of 4 to 6 when moist or dry. Texture is fine sandy loam or loam with strata of coarser or finer material.

The Ab horizon has hue of 5YR to 10YR, value of 3 to 5 when dry and 2 to 4 when moist, and chroma of 2 to 4 when moist or dry. Texture is fine sandy loam, clay loam, or loam. Depth to the Ab horizon ranges from 30 to 50 inches.

Grainola Series

The Grainola series consists of moderately deep, well drained, slowly permeable soils that formed in material weathered from calcareous shale or siltstone under a cover of mid and short prairie grasses. These very gently sloping to moderately steep soils are on ridgetops and side slopes. Slopes are convex and range from 2 to 20 percent. The Grainola series is a member of the fine, mixed, thermic family of Vertic Haplustalfs.

Grainola soils are associated with the Bethany, Loco, Lucien, Nash, Renfrow, and Zaneis soils. Bethany and Renfrow soils have a mollic epipedon, have a solum more than 40 inches thick, and occur in slightly higher areas. Loco and Lucien soils have a mollic epipedon, have a solum less than 20 inches thick, and have a control section with less than 35 percent clay content. They occur on ridgetops, but Loco soils are at lower elevations. Nash soils do not have an argillic horizon, have a coarse-silty control section, and occur slightly lower than the Grainola soils. Zaneis soils have a fine-loamy control section, have a solum more than 40 inches thick, and occur in slightly higher areas.

Typical pedon of Grainola clay loam, 5 to 20 percent slopes, 100 feet south and 800 feet east of the northwest corner of sec. 25, T. 4 N., R. 3 W.

A1—0 to 5 inches; reddish brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; weak medium subangular blocky structure; very hard, very firm; many fine roots; common pores; calcareous; moderately alkaline; abrupt smooth boundary.

B2t—5 to 25 inches; red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; weak medium blocky structure; very hard, very firm; common very fine roots; few pores; few soft bodies and concretions of calcium carbonate 2 to 4 millimeters in diameter; calcareous; moderately alkaline; gradual smooth boundary.

B3—25 to 35 inches; red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; weak coarse blocky structure; very hard, very firm; few seams and bodies of greenish gray shaly clay; few soft bodies and concretions of calcium carbonate; fragments of shale less than 3 inches in diameter make up 5 percent by volume; calcareous; moderately alkaline; clear wavy boundary.

Cr—35 to 60 inches; red (2.5YR 5/6) shale bedrock; moderately alkaline.

Solum thickness and depth to soft siltstone or shale bedrock range from 20 to 40 inches. In most summers this soil has cracks 1/2 inch or more wide and 15 to 25 inches deep. Cobbles are present in an area south of State Highway 7, at the base of the Arbuckle Mountains.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. Texture is clay loam or cobbly clay loam with limestone fragments ranging from 0 to 35 percent by volume. Reaction is mildly alkaline or moderately alkaline.

The B2t horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 3 to 6. Texture is clay or silty clay. Limestone fragments range from 0 to 15 percent by volume.

The B3 horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 3 to 6. Texture is clay, silty clay, shaly clay, or shaly silty clay. Coarse fragments less than 3 inches in diameter range from 5 to 20 percent by volume.

The Cr horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 2 to 6. The bedrock is shale or siltstone that is streaked with grayish, brownish, or olive colors. Some pedons have thin strata of sandstone interbedded with shale.

Justin Series

The Justin series consists of deep, well drained, moderately slowly permeable soils that formed in loamy sediments under a cover of tall prairie grasses. These nearly level to very gently sloping soils are on broad smooth ridges of the uplands. Slopes range from 0 to 3 percent. The Justin series is a member of the fine-loamy, mixed, thermic family of Udic Paleustolls.

Justin soils are associated with the Galey and Konawa soils. Galey and Konawa soils are slightly lower than the Justin soils and do not have a mollic epipedon.

Typical pedon of Justin loam, 0 to 1 percent slopes, 2,640 feet north and 100 feet east of the southwest corner of sec. 13, T. 4 N., R. 3 E.

A1—0 to 14 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; many fine roots; common fine pores; neutral; gradual smooth boundary.

B21t—14 to 24 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate fine subangular blocky structure; hard, firm; many fine roots; few fine pores; thin clay films on faces of peds; slightly acid; gradual smooth boundary.

B22t—24 to 44 inches; strong brown (7.5YR 5/6) clay loam, strong brown (7.5YR 4/6) moist; moderate coarse subangular blocky structure; very hard, very firm; common fine roots; few fine pores; clay films on faces of peds; slightly acid; gradual smooth boundary.

B23t—44 to 72 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) moist; many coarse distinct red (10R 4/6) mottles; weak coarse blocky structure; very hard, very firm; few fine and very fine roots; clay films on faces of peds; mildly alkaline.

Depth to bedrock is more than 60 inches.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 or 3. Reaction is slightly acid or neutral.

The B21t horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 or 3. Some pedons have mottles in shades of red or brown. Reaction is slightly acid or neutral.

The B22t horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 6. Some pedons have mottles in shades of red or brown. Texture is clay loam or sandy clay loam. Reaction is slightly acid or neutral.

The B23t horizon has hue of 5YR to 10YR, value of 4 to 6, and chroma of 2 to 6. Mottles are in shades of red or brown. Texture is clay loam or sandy clay loam. Reaction is neutral to moderately alkaline.

Keokuk Series

The Keokuk series consists of deep, well drained, moderately permeable, nearly level soils on broad, smooth flood plains of the Washita River. They formed in loamy alluvial sediments under a cover of tall prairie grasses and scattered trees. Slopes range from 0 to 1 percent. The Keokuk series is a member of the coarse-silty, mixed, thermic family of Fluventic Haplustolls.

The Keokuk soils are associated with the Amber, Asher, Dale, Lela, and McLain soils. Amber soils are more sloping and do not have a mollic epipedon. Asher and Dale soils are on similar positions and have a fine-silty control section. Lela and McLain soils are slightly lower and have a fine control section.

Typical pedon of Keokuk silt loam, rarely flooded, 1,320 feet west and 1,320 feet south of the northeast corner of sec. 8, T. 3 N., R. 1 E.

Ap—0 to 8 inches; dark brown (7.5YR 4/2) silt loam, dark brown (7.5YR 3/2) moist; weak fine and medium granular structure; slightly hard, very friable; many fine roots; neutral; clear smooth boundary.

A11—8 to 16 inches; reddish brown (5YR 4/3) silt loam, dark reddish brown (5YR 3/3) moist; weak fine and medium granular structure; slightly hard, very friable; many fine roots; common pores; neutral; gradual smooth boundary.

B21—16 to 24 inches; red (2.5YR 4/6) silt loam, dark red (2.5YR 3/6) moist; weak fine and medium granular structure; slightly hard, very friable; common fine roots; many pores; few areas filled with darker material; mildly alkaline; gradual smooth boundary.

B22—24 to 48 inches; red (2.5YR 5/6) silt loam, red (2.5YR 4/6) moist; weak fine and medium granular structure; slightly hard, very friable; few fine roots; few pores; few soft bodies and threads of calcium carbonate starting at 35 inches; calcareous; moderately alkaline; gradual smooth boundary.

C—48 to 80 inches; red (2.5YR 5/6) very fine sandy loam, red (2.5YR 4/6) moist; massive; slightly hard, very friable; few thin strata of loam and silt loam; a few soft masses and films of calcium carbonate; few calcium carbonate concretions; calcareous; moderately alkaline.

Depth to bedrock is more than 60 inches. Depth to the water table is more than 6 feet.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. Reaction is slightly acid to moderately alkaline.

The B2 horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 8. Texture is silt loam or very fine sandy loam. Reaction is neutral to moderately alkaline.

The C horizon has hue of 2.5YR or 5YR, value of 4 to 7, and chroma of 4 to 8. Texture is very fine sandy loam, silt loam, or loam. Most pedons are stratified with coarser and finer textures below 40 inches. Reaction is mildly alkaline or moderately alkaline.

Konawa Series

The Konawa series consists of deep, well drained, moderately permeable soils. These very gently sloping to moderately steep soils are on ridgetops and side slopes along high stream terraces, mainly in the northeastern part of the county. These soils formed in sandy and loamy sediments under a cover of oak trees with an understory of tall grasses. Slopes range from 1 to 20 percent. The Konawa series is a member of the fine-loamy, mixed, thermic family of Ultic Haplustalfs.

Konawa soils are associated with the Galey and Justin soils. Galey soils are on broad smooth ridgetops, do not decrease in clay content with depth, and are mottled in the lower part of the B2t horizon. Justin soils, on broad smooth divides, have a mollic epipedon.

Typical pedon of Konawa loamy fine sand, 3 to 8 percent slopes, 200 feet north and 225 feet west of the southeast corner of sec. 2, T. 4 N., R. 3 E.

A1—0 to 6 inches; pinkish gray (7.5YR 6/2) loamy fine sand, dark brown (7.5YR 4/2) moist; weak fine granular structure; soft, loose; many fine and medium roots; strongly acid; clear smooth boundary.

A2—6 to 16 inches; pinkish gray (7.5YR 7/2) loamy fine sand, light brown (7.5YR 6/4) moist; weak fine granular structure; soft, loose; many fine and medium roots; strongly acid; clear smooth boundary.

B21t—16 to 24 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak coarse subangular blocky structure; very hard, firm; common medium and fine roots; common pores; clay films on faces of peds; medium acid; diffuse smooth boundary.

B22t—24 to 45 inches; yellowish red (5YR 5/8) sandy clay loam, yellowish red (5YR 4/8) moist; moderate coarse prismatic structure; hard, firm; common fine roots; common pores; clay films on faces of peds; medium acid; diffuse smooth boundary.

B3—45 to 58 inches; reddish yellow (5YR 6/8) fine sandy loam, yellowish red (5YR 4/8) moist; weak coarse prismatic structure; hard, friable; few fine roots; few pores; medium acid; diffuse smooth boundary.

C—58 to 72 inches; reddish yellow (5YR 6/8) fine sandy loam, yellowish red (5YR 4/8) moist; massive; hard, friable; few spots of clean sand grains; medium acid.

Solum thickness ranges from 48 to 70 inches. The thickness of the A1 and A2 horizons combined ranges from 4 inches in some eroded spots to 18 inches.

The A1 or Ap horizon has hue of 5YR to 10YR, value of 4 to 7, and chroma of 2 to 4. Texture is loamy fine sand or fine sandy loam. Reaction is strongly acid to slightly acid.

The A2 horizon has hue of 7.5YR or 10YR, value of 5 to 8, and chroma of 2 to 4. Texture and reaction are the same as in the A1 or Ap horizon. In some pedons, there is no A2 horizon.

The B2t horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 8. Texture is fine sandy loam or sandy clay loam. Reaction is strongly acid or medium acid.

The B3 horizon has colors similar to those in the B2t horizon. Texture is fine sandy loam or sandy clay loam. Reaction is strongly acid to neutral. A few clean sand grains are present in some pedons.

The C horizon has colors similar to those in the B2t horizon. Texture is loamy fine sand or fine sandy loam. Reaction ranges from strongly acid to neutral.

Konsil Series

The Konsil series consists of deep, well drained, moderately permeable soils. These nearly level to sloping soils are on ridgetops and side slopes of uplands mainly along the north side of WildHorse Creek. These soils formed in material weathered from weakly cemented sandstone or packsand under a cover of oak trees with an understory of tall grasses. Slopes range from 0 to 8 percent. The Konsil series is a member of the fine-loamy, siliceous, thermic family of Ultic Paleustalfs.

The Konsil soils are associated with Darnell, Newalla, and Stephenville soils. Darnell soils do not have a B2t horizon, have a solum less than 20 inches thick, and occur on ridge crests. Newalla soils have a fine-loamy over clayey control section and occur in areas similar to those of the Konsil soils. Stephenville soils are on side slopes similar to those of the Konsil soils and have a solum 20 to 40 inches thick over sandstone.

Typical pedon of Konsil loamy fine sand, 3 to 8 percent slopes, 1,400 feet north and 1,200 feet west of the southeast corner of sec. 34, T. 1 N., R. 3 W.

A1—0 to 9 inches; yellowish brown (10YR 5/4) loamy fine sand, dark yellowish brown (10YR 4/4) moist; weak fine granular structure; soft, very friable; many fine roots; strongly acid; clear smooth boundary.

A2—9 to 14 inches; light brown (7.5YR 6/4) loamy fine sand, brown (7.5YR 5/4) moist; weak fine granular structure; soft, very friable; many fine roots; strongly acid; clear smooth boundary.

B21t—14 to 27 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak coarse subangular blocky structure; very hard, firm; many fine and common medium roots; common pores; clay films on faces of peds; medium acid; diffuse smooth boundary.

B22t—27 to 37 inches; reddish yellow (5YR 6/8) sandy clay loam, yellowish red (5YR 4/8) moist; moderate coarse prismatic structure; hard, firm; common fine and medium roots; common pores; clay films on faces of peds; medium acid; diffuse smooth boundary.

B23t—37 to 62 inches; reddish yellow (5YR 6/8) fine sandy loam, yellowish red (5YR 5/8) moist; weak coarse prismatic structure; hard, friable; few fine roots; common pores; patchy clay films on faces of peds; medium acid; diffuse smooth boundary.

Cr—62 to 70 inches; reddish yellow (5YR 6/8) weakly cemented sandstone.

Depth to soft bedrock is 60 to more than 80 inches. The combined thickness of the A1 and A2 horizons ranges from 5 inches in some eroded areas to 18 inches in some uneroded areas.

The A1 horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 or 4. Reaction is strongly acid or medium acid.

The A2 horizon has hue of 7.5YR or 10YR, value of 4 to 7, and chroma of 2 to 4. Reaction is the same as in the A1 horizon. Some pedons do not have an A2 horizon.

The B2t horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 8. Some pedons have hue of 7.5YR or 10YR below a depth of 40 inches. Texture is fine sandy loam or sandy clay loam. Clean sand grains occur in the lower part of some pedons. Reaction is strongly acid or medium acid.

The Cr layer is reddish, brownish, yellowish, or grayish sandstone or packsand.

Lela Series

The Lela series consists of deep, somewhat poorly drained, very slowly permeable soils that formed in thick clayey sediments. These nearly level to slightly concave soils are on flood plains along the outer edge of the Washita River. Slopes are less than 1 percent. The Lela series is a member of the fine, mixed, thermic family of Udic Chromusterts.

Lela soils are associated with the Amber, Asher, Dale, Keokuk, and McLain soils. Amber soils are on side slopes and have a coarse-silty control section. Asher and Dale soils are in slightly higher areas and have a fine-silty control section. Keokuk soils are in slightly higher areas and have a coarse-silty control section. McLain soils are in similar areas and have an argillic horizon.

Typical pedon of Lela clay, rarely flooded, 1,550 feet east and 325 feet south of the northwest corner of sec. 30, T. 4 N., R. 1 E.

A11—0 to 12 inches; dark reddish gray (5YR 4/2) clay, dark reddish brown (5YR 3/2) moist; strong fine blocky structure; very hard, very firm; common fine roots; mildly alkaline; gradual smooth boundary.

A12—12 to 24 inches; dark reddish gray (5YR 4/2) clay, dark reddish brown (5YR 3/2) moist; moderate fine blocky structure; extremely hard, extremely firm; few fine roots; few pores; few slickensides in lower part; few vertical cracks 1/8 to 1/2 inch wide filled with material from the A11 horizon; mildly alkaline; gradual smooth boundary.

AC—24 to 42 inches; red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; weak coarse blocky structure; extremely hard, extremely firm; few very fine roots; common intersecting slickensides; few vertical cracks filled with dark reddish gray clay; calcareous; moderately alkaline; gradual smooth boundary.

C—42 to 72 inches; red (2.5YR 5/6) clay, red (2.5YR 4/6) moist; massive; extremely hard, extremely firm; calcareous; moderately alkaline.

Depth to bedrock is more than 60 inches, and depth to a water table is more than 6 feet.

The A horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 2 or 3. In some places, the A horizon has a moist chroma of 1 and is less than 12 inches thick in more than half the pedon. Reaction is neutral or mildly alkaline.

The AC horizon has hue of 2.5YR or 5YR, value of 3 to 6, and chroma of 3 to 6. Intersecting slickensides range from few to common. Reaction is mildly alkaline or moderately alkaline.

The C horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 6. Reaction is mildly alkaline or moderately alkaline.

Loco Series

The Loco series consists of shallow, well drained, moderately permeable soils. These gently sloping to sloping soils are on irregular ridgetops of uplands. They formed in material weathered from interbedded gray clayey shale and siltstone. Slopes range from 3 to 8 percent. The Loco series is a member of the loamy, mixed, thermic, shallow family of Typic Haplustolls.

Loco soils are associated with the Bethany, Grainola, Lucien, Nash, Renfrow, and Zaneis soils. Bethany, Grainola, and Renfrow soils have a fine control section, have an argillic horizon, and occur in slightly higher areas. Lucien soils have hue of 5YR or redder in the B horizon and occur in areas similar to those of the Loco soils. Nash soils have a solum more than 20 inches thick and occur on side slopes that are slightly lower than the Loco soils. Zaneis soils are slightly higher, have a fine-loamy control section, and have a solum more than 20 inches thick.

Typical pedon of Loco silty clay loam, 3 to 8 percent slopes, 900 feet north and 2,100 feet east of the southwest corner of sec. 19, T. 2 N., R. 3 W.

A1—0 to 6 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium and fine granular structure; slightly hard, friable; many roots; many wormcasts; calcareous; moderately alkaline; gradual smooth boundary.

B2—6 to 17 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; strong medium and fine subangular blocky structure; hard, friable; many fine roots; common wormcasts; few soft fragments of siltstone; few soft bodies and films of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

Cr—17 to 26 inches; gray (5Y 6/1) clayey shale, gray (5Y 5/1) moist; massive; extremely hard, firm; level bedded, fractured; few roots in seams and fractures; many films and soft bodies of calcium carbonate; calcareous; mildly alkaline.

Solum thickness and depth to bedrock range from 10 to 20 inches. The soil is moderately alkaline or mildly alkaline throughout the solum.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3.

The B2 horizon has hue of 10YR to 5Y, value of 5 to 7, and chroma of 2 to 4. Texture is silt loam or silty clay loam. Soft bodies of calcium carbonate range from few to many.

The Cr horizon has hue of 2.5Y or 5Y, value of 6 or 7, and chroma of 1 to 4. The Cr horizon is calcareous, clayey shale that is easily dug with a spade. Some pedons have interbedded siltstone.

Lucien Series

The Lucien series consists of shallow, well drained soils that formed in material weathered from sandstone. These gently sloping to steep soils are intermingled on ridge crests and hillsides on prairie uplands. Permeability is moderately rapid. Slopes range from 5 to 30 percent. The Lucien series is a member of the loamy, mixed, thermic, shallow family of Typic Haplustolls.

Lucien soils are associated with Bethany, Grainola, Loco, Nash, Renfrow, and Zaneis soils. Bethany, Grainola, and Renfrow soils have a fine control section, have an argillic horizon, have a solum more than 20 inches thick, and are in slightly higher areas. Loco soils have a hue of 7.5YR or yellower in the B2 horizon. Nash and Loco soils are in areas similar to those of the Lucien soils. Nash soils have a solum more than 20 inches thick. Zaneis soils have an argillic horizon, have a solum more than 20 inches thick, and occur in slightly higher areas.

Typical pedon of Lucien loam (fig. 16) in an area of Lucien-Nash complex, 5 to 12 percent slopes, 950 feet north and 575 feet west of the southeast corner of sec. 18, T. 4 N., R. 4 W.

A—0 to 4 inches; reddish brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) moist; moderate fine granular structure; slightly hard, very friable; many fine roots; mildly alkaline; clear smooth boundary.

B2—4 to 12 inches, reddish brown (5YR 5/4) very fine sandy loam, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, friable; many fine roots; common pores; calcareous; moderately alkaline; gradual smooth boundary.

Cr—12 to 15 inches; red (2.5YR 5/6) fine-grained sandstone, red (2.5YR 4/6) moist; interbedded with siltstone and clayey shales; calcareous in seams and fractures; moderately alkaline.

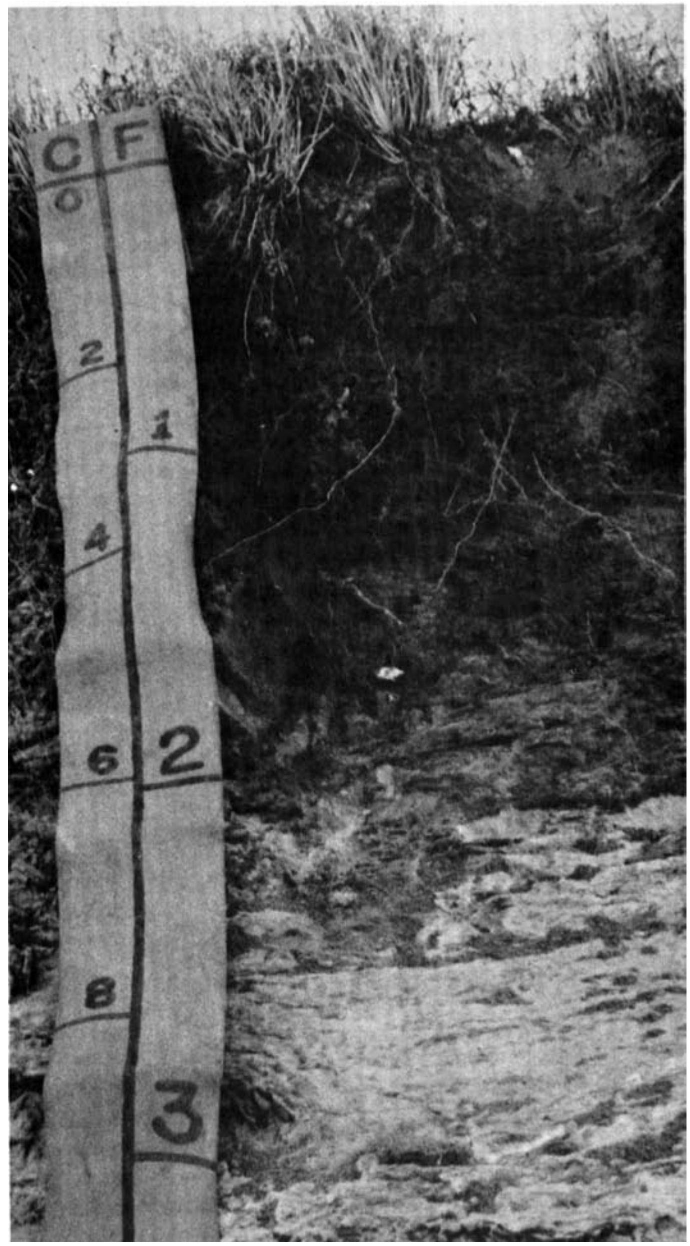

Figure 16.—Profile of Lucien loam in an area of Lucien-Nash complex, 5 to 12 percent slopes. Sandstone strata are below a depth of about 18 inches. Tape shows both feet and centimeters.

Thickness of the solum and depth to bedrock range from 10 to 20 inches.

The A horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 2 to 4. Texture is loam or stony loam. Coarse fragments less than 3 inches in diameter make up about 0 to 10 percent of the volume; fragments more than 3 inches in diameter make up as much as 20 percent of the volume. Reaction ranges from neutral to moderately alkaline.

The B2 horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 8. Texture is loam, very fine sandy loam, silt loam, or fine sandy loam. Coarse fragments less than 3 inches in diameter make up about 0 to 5 percent of the volume. The soil is mildly alkaline or moderately alkaline and in some pedons is calcareous.

The Cr horizon is reddish weakly cemented sandstone. In some pedons, the Cr horizon is sandstone interbedded with clayey shale and siltstone.

The Lucien soils in this survey area are taxadjuncts to the Lucien series because they have an epipedon slightly too thin to be mollic and the B2 horizon is slightly more alkaline. These differences have little effect on their use, management, and behavior.

McLain Series

The McLain series consists of deep, moderately well drained, slowly permeable soils that formed in clayey and loamy alluvium under a cover of prairie grasses. These nearly level soils are on broad, smooth flood plains along the Washita River. Slopes are 0 to 1 percent. The McLain series is a member of the fine, mixed, thermic family of Pachic Argiustolls.

The McLain soils are associated with the Amber, Asher, Dale, Keokuk, and Lela soils. Amber soils, on side slopes, have a coarse-silty control section, do not have an argillic horizon, and do not have a mollic epipedon. The Asher, Dale, and Keokuk soils are on slightly higher positions; the Asher and Dale soils have a fine-silty control section, but Keokuk soils have a coarse-silty control section. Lela soils are on similar landscapes but have intersecting slickensides and do not have an argillic horizon.

Typical pedon of McLain silty clay loam, rarely flooded, 1,600 feet west and 2,200 feet south of the northeast corner of sec. 16, T. 4 N., R. 3 W.

Ap—0 to 6 inches; dark brown (7.5YR 4/2) silty clay loam, dark brown (7.5YR 3/2) moist; moderate medium granular structure; hard, friable; common medium and fine roots; neutral; clear smooth boundary.

A1—6 to 15 inches; dark reddish gray (5YR 4/2) silty clay loam, dark reddish brown (5YR 2/2) moist; moderate medium granular structure; hard, friable; common fine roots; common pores; neutral; smooth gradual boundary.

B2t—15 to 27 inches; reddish brown (5YR 4/3) silty clay, dark reddish brown (5YR 3/3) moist; weak to medium fine blocky structure; very hard, very firm; few fine roots; few pores; continuous clay films on faces of peds; mildly alkaline; gradual smooth boundary.

B3—27 to 40 inches; reddish brown (2.5YR 4/4) silty clay loam, dark reddish brown (2.5YR 3/4) moist; weak medium subangular blocky structure; very hard, firm; few very fine roots; patchy clay films on faces of peds; mildly alkaline; gradual smooth boundary.

C—40 to 72 inches; reddish brown (2.5YR 5/4) silty clay loam, reddish brown (2.5YR 4/4) moist; massive; hard, friable; few soft bodies of calcium carbonate; calcareous; moderately alkaline.

Depth to bedrock is more than 60 inches. Depth to the water table is more than 6 feet. Soft powdery secondary carbonates are at depths of 36 to 48 inches.

The A horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 2 or 3. Reaction is slightly acid or neutral.

The B2t horizon has hue of 2.5YR or 5YR, value of 3 to 5, and chroma of 3 or 4. Texture is silty clay loam or silty clay. Reaction ranges from neutral to moderately alkaline.

The B3 and C horizons have hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 3 or 4. Texture and reaction of the B3 horizon are the same as in the B2t horizon. Texture of the C horizon is silt loam, silty clay loam, or silty clay.

Nash Series

The Nash series consists of moderately deep, well drained, moderately permeable soils that formed in material weathered from sandstone. Areas of these sloping to strongly sloping soils are intermingled on ridge crests and hillsides of uplands. Slopes are 5 to 12 percent. The Nash series is a member of the coarse-silty, mixed, thermic family of Udic Haplustolls.

Nash soils are associated with the Bethany, Grainola, Loco, Lucien, Renfrow, and Zaneis soils. Bethany, Grainola, and Renfrow soils have an argillic horizon, have a fine control section, and are usually in slightly higher areas. Loco and Lucien soils have a solum 10 to 20 inches thick and are in areas similar to those of the Nash soils. Zaneis soils have a fine-loamy control section, have an argillic horizon, and are in slightly higher areas.

Typical pedon of Nash silt loam in an area of Lucien-Nash complex, 5 to 12 percent slopes, 1,200 feet north and 180 feet east of the southwest corner of sec. 17, T. 4 N., R. 4 W.

A1—0 to 10 inches; reddish brown (5YR 5/3) silt loam, dark reddish brown (5YR 3/3) moist; weak fine granular structure; slightly hard, very friable; common fine roots; neutral; gradual smooth boundary.

B2—10 to 23 inches; reddish brown (5YR 5/4) silt loam, reddish brown (5YR 4/4) moist; weak fine and medium subangular blocky structure; slightly hard, friable; common fine roots; few pores; moderately alkaline; gradual smooth boundary.

B3—23 to 28 inches; yellowish red (5YR 5/6) very fine sandy loam, yellowish red (5YR 4/6) moist; weak coarse subangular blocky structure; slightly hard, friable; few fine roots; about 5 percent by volume fragments of sandstone and siltstone less than 3 inches in diameter; calcareous; moderately alkaline; abrupt wavy boundary.

Cr—28 to 32 inches; yellowish red (5YR 5/6) fine-grained sandstone; moderately alkaline.

Thickness of the solum and depth to sandstone bedrock range from 20 to 40 inches.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3.

The B2 horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. Texture is very fine sandy loam, silt loam, or loam.

The B3 horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 6 to 8. Texture is very fine sandy loam or loam.

The Cr horizon is reddish brown, yellowish red, or reddish yellow weakly to strongly cemented sandstone and siltstone.

Newalla Series

The Newalla series consists of deep, moderately well drained, very slowly permeable soils. These very gently sloping to sloping soils are on broad, smooth ridge crests and side slopes of uplands. They formed in material weathered from clayey shale or sandstone under a cover of trees with an understory of native grasses. Slopes range from 1 to 8 percent. The Newalla series is a member of the fine-loamy over clayey, siliceous, thermic family of Udic Haplustalfs.

The Newalla soils are associated with the Darnell, Konsil, and Stephenville soils. Darnell soils, on ridge crests, have a solum less than 20 inches thick, do not have an argillic horizon, and have a loamy control section. Konsil and Stephenville soils are on similar landscapes and have a fine-loamy control section.

Typical pedon of Newalla fine sandy loam, 1 to 3 percent slopes, 1,200 feet north and 700 feet east of the southwest corner of sec. 16, T. 3 N., R. 4 W.

A1—0 to 5 inches; brown (7.5YR 5/2) fine sandy loam, dark brown (7.5YR 4/2) moist; moderate medium and fine granular structure; slightly hard, very friable; many fine and common roots; slightly acid; clear smooth boundary.

A2—5 to 8 inches; light reddish brown (5YR 6/4) fine sandy loam, reddish brown (5YR 5/4) moist; weak fine granular structure; soft, very friable; many fine and common roots; medium acid.

B21t—8 to 12 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; hard, firm; many fine and medium roots; common pores; medium acid; clear wavy boundary.

IIB22t—12 to 22 inches; reddish brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; moderate medium blocky structure; extremely hard, very firm; common very fine and fine roots; common pores; few faces of peds with light reddish brown coatings; distinct continuous clay films on faces of peds; medium acid; gradual smooth boundary.

IIB23tca—22 to 38 inches; red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; moderate medium and coarse blocky structure; extremely hard, very firm; few very fine and fine roots; few pores; distinct continuous clay films on faces of peds; few medium black concretions; common soft bodies of calcium carbonate; mildly alkaline; gradual smooth boundary.

IIB3—38 to 50 inches; light red (2.5YR 6/8) sandy clay, red (2.5YR 5/8) moist; common medium distinct reddish yellow (5YR 6/6) mottles; weak medium subangular blocky structure; hard, firm; few very fine roots; patchy clay films on faces of peds; few soft bodies of calcium carbonate; moderately alkaline; clear smooth boundary.

IICr—50 to 65 inches; reddish yellow (5YR 6/6) soft sandstone and clayey shale, yellowish red (5YR 5/6) moist; massive; hard, firm; moderately alkaline.

Depth to bedrock is 40 to 60 inches.

The A1 horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. Reaction ranges from medium acid to neutral.

The A2 horizon has hue of 5YR to 10YR, value of 4 to 6, and chroma of 3 or 4. In some profiles, the A1 and A2 horizons have been mixed by tillage. Reaction ranges from medium acid to neutral.

The B21t horizon has hue of 2.5YR or 5YR, value of 5 or 6, and chroma of 3 to 6. Texture is sandy clay loam or clay loam. Reaction ranges from medium acid to neutral.

The IIB22t and IIB23tca horizons have hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 8. Reaction is medium acid to mildly alkaline.

The IIB3 horizon has hue of 10R to 5YR, value of 4 to 6, and chroma of 4 to 8. Most pedons have mottles in shades of red, yellow, or brown. Texture is clay or sandy clay. Reaction is mildly alkaline or moderately alkaline.

The IICr horizon is reddish soft shale or clayey shale, and in some areas it is interbedded with thin layers of sandstone.

Norge Series

The Norge series consists of deep, well drained, moderately slowly permeable soils. These nearly level or very gently sloping soils are on broad, convex flats on high stream terraces. They formed in material weathered from loamy sediments under a cover of tall grasses. Slopes range from 0 to 3 percent. The Norge series is a member of the fine-silty, mixed, thermic family of Udic Paleustolls.

The Norge soils are associated with the Teller and Vanoss soils. Teller soils are on the side slopes and have a fine-loamy control section. Vanoss soils are in areas similar to those of the Norge soils, and have a control section that decreases in clay content by more than 20 percent within a depth of 60 inches.

Typical pedon of Norge silt loam, 0 to 1 percent slopes (fig. 17), 780 feet south and 50 feet west of the northeast corner of sec. 22, T. 4 N., R. 4 W.

A1—0 to 11 inches; brown (7.5YR 5/2) silt loam, dark brown (7.5YR 3/2) moist; weak medium granular structure; hard, friable; many fine roots; neutral; clear smooth boundary.

B1—11 to 17 inches; reddish brown (5YR 5/3) silt loam, dark reddish brown (5YR 3/3) moist; moderate medium granular structure; hard, friable; many fine roots; common pores; slightly acid; gradual smooth boundary.

B21t—17 to 30 inches; reddish brown (5YR 5/4) silty clay loam, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure; very hard, firm; common fine roots; common pores; clay films on faces of peds; slightly acid; gradual smooth boundary.

B22t—30 to 45 inches; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; moderate coarse subangular blocky structure; very hard, firm; common fine roots; few pores; clay films on faces of peds; slightly acid; gradual smooth boundary.

B23t—45 to 72 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; weak coarse subangular blocky structure; hard, firm; few fine roots; patchy clay films on faces of peds; slightly acid.

Depth to bedrock is more than 60 inches.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. Reaction ranges from medium acid to neutral.

The B1 horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. Texture is silt loam or silty clay loam. Reaction ranges from medium acid to neutral.

The B21t and B22t horizons have hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. Texture is clay loam or silty clay loam. Reaction ranges from medium acid to mildly alkaline.

The B23t horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. Texture is silty clay loam or clay loam. Reaction ranges from slightly acid to moderately alkaline.

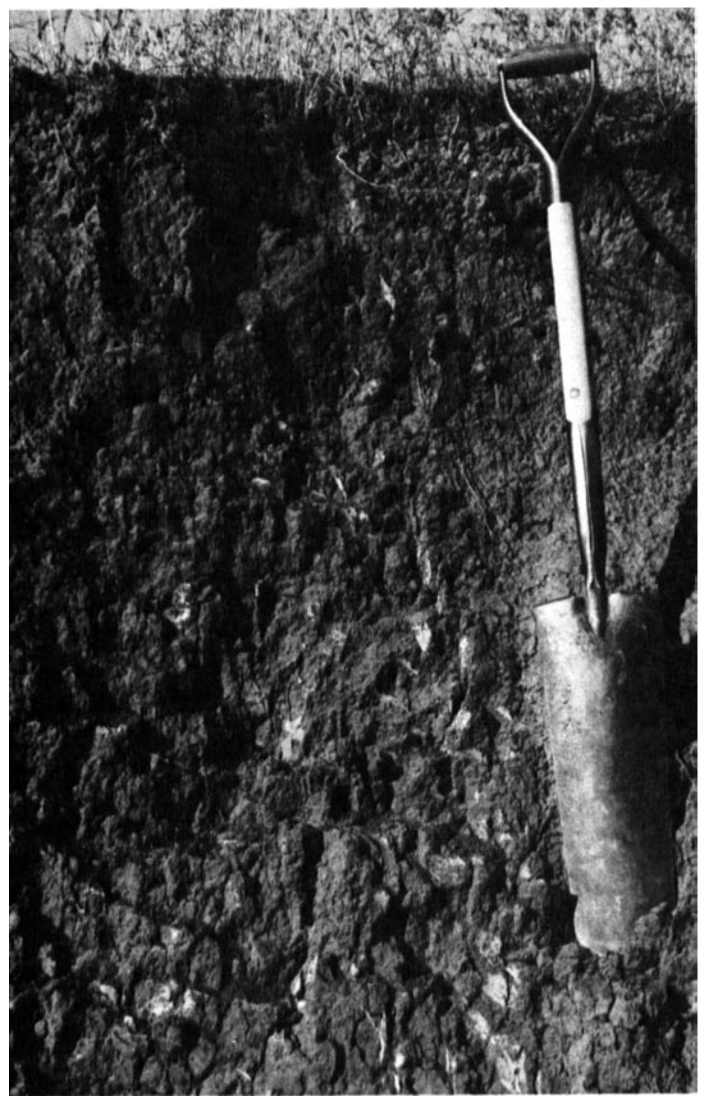

Figure 17.—Profile of Norge silt loam, 0 to 1 percent slopes. Note subangular structure in the subsoil.

Port Series

The Port series consists of deep, well drained, moderately permeable, nearly level soils on smooth, narrow to broad flood plains. These soils formed in loamy alluvium under a cover of tall grasses and scattered hardwood trees. Slopes range from 0 to 1 percent. The Port series is a member of the fine-silty, mixed, thermic family of Cumulic Haplustolls.

Port soils are associated with Asa, Bergstrom, Elandco, Gaddy, Garvin, Gracemont, Pulaski, and Yahola soils. Asa, Bergstrom, and Elandco soils occur in similar landscapes. Asa soils have a mollic epipedon less than 20 inches thick. Bergstrom soils are calcareous throughout the control section. Elandco soils have hue of 10YR or yellow throughout the lower part of the solum. Gaddy soils are slightly lower than Port soils and have a sandy control section. Garvin soils are on similar landscapes and have a fine control section. Gracemont soils occur on slightly lower landscapes, have a coarse-loamy control section, and have a water table near the surface during winter and summer. Pulaski and Yahola soils occur on similar landscapes and have a coarse-loamy control section.

Typical pedon of Port silt loam, occasionally flooded, 1,400 feet south and 150 feet west of the northeast corner of sec. 20, T. 3 N., R. 3 W.

A11—0 to 14 inches; reddish brown (5YR 4/3) silt loam, dark reddish brown (5YR 3/3) moist; moderate medium granular structure; soft, very friable; many fine roots; neutral; clear smooth boundary.

A12—14 to 27 inches; dark reddish brown (5YR 3/3) silt loam, dark reddish brown (5YR 2/2) moist; moderate coarse granular structure; slightly hard, friable; common fine roots; common pores; neutral; gradual smooth boundary.

B2—27 to 48 inches; reddish brown (5YR 4/4) silty clay loam, dark reddish brown (5YR 3/4) moist; weak fine subangular blocky structure; hard, firm; few fine roots; common pores; thin strata of darker soil; common bodies and films of calcium carbonate; calcareous; moderately alkaline; diffuse smooth boundary.

C—48 to 72 inches; reddish brown (2.5YR 5/4) silt loam, reddish brown (2.5YR 4/4) moist; massive; hard, firm; few thin strata of dark reddish brown (5YR 3/4) silty clay loam; common bodies and films of calcium carbonate; calcareous; moderately alkaline.

Depth to bedrock is more than 60 inches. Depth to the water table is more than 6 feet. Depth of secondary carbonates ranges from 20 to 60 inches.

The A horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 2 or 3. Texture is silt loam or fine sandy loam. Thickness of the overwash in the A1 horizon ranges from 8 to 18 inches. The overwash material includes chroma of 4. Reaction ranges from medium acid to mildly alkaline.

The B2 horizon has hue of 2.5YR to 5YR, value of 4 to 6, and chroma of 3 to 6. Texture is silt loam, loam, silty clay loam, or clay loam. Reaction ranges from neutral to moderately alkaline.

In the C horizon, colors and texture are similar to those of the B2 horizon. Most pedons contain thin strata of coarser or finer texture below 40 inches.

Pulaski Series

The Pulaski series consists of deep, well drained, moderately rapidly permeable, nearly level soils that occur on narrow to broad flood plains. These soils formed in loamy alluvium under a cover of tall grasses and scattered hardwood trees. Slopes range from 0 to 1 percent. The Pulaski series is a member of the coarse-loamy, mixed, nonacid, thermic family of Typic Ustifluvents.

Pulaski soils are associated with Asa, Bergstrom, Elandco, Gaddy, Garvin, Gracemont, Port, and Yahola soils. Asa, Bergstrom, Elandco, and Port soils have a mollic epipedon, have a fine-silty control section, and occur on similar landscapes. Gaddy soils have a sandy control section and occur on slightly lower landscapes. Garvin soils have a mollic epipedon, have a fine control section, and occur on similar landscapes. Gracemont soils have a coarse-loamy control section, have a water table near the surface during the winter and spring, and occur on slightly lower landscapes. Yahola soils are calcareous throughout the control section and occur on similar landscapes.

Typical pedon of Pulaski fine sandy loam, occasionally flooded, 1,100 feet north and 2,750 feet east of the southwest corner of sec. 2, T. 3 N., R. 1 W.

A1—0 to 12 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak fine and very fine granular structure; slightly hard, very friable; many fine roots; slightly acid; clear smooth boundary.

C1—12 to 46 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; massive; slightly hard, very friable; few fine roots; thin strata of darker fine sandy loam; neutral; gradual smooth boundary.

C2—46 to 65 inches; reddish yellow (5YR 6/8) fine sandy loam, yellowish red (5YR 5/8) moist; massive; soft, friable; thin strata of clay loam and loamy fine sand; mildly alkaline.

Depth of this Pulaski soil is more than 60 inches. Reaction ranges from medium acid to neutral above 40 inches and is medium acid to moderately alkaline below 40 inches.

The A horizon has hue of 5YR or 7.5YR, value of 4 to 7, and chroma of 3 to 6. Texture is mostly fine sandy loam but includes loam and loamy fine sand.

The C horizon has hue of 2.5YR to 7.5YR, value of 5 to 7, and chroma of 4 to 8. Texture ranges from loamy fine sand to loam, but it averages fine sandy loam in the 10- to 40-inch control section. Strata of finer or coarser materials occur throughout the C horizon.

Rayford Series

The Rayford series consists of shallow, well drained, moderately permeable, sloping to moderately steep soils on side slopes of hills or on ridges on the north side of the Arbuckle Mountains. These soils formed in material from limestone conglomerate under a cover of short prairie grasses. Slopes range from 5 to 20 percent. The Rayford series is a member of the loamy-skeletal, mixed, thermic family of Lithic Haplustolls.

Rayford soils are associated with Burleson, Chigley, Clarita, Durant, Tussy, and Wilson soils. Burleson and Clarita soils have a fine control section and are more than 20 inches thick over bedrock. Burleson soils are on broad flats, and Clarita soils are on lower side slopes. Chigley, Durant, and Wilson soils have a fine control section, are more than 20 inches thick over bedrock, and have an argillic horizon. Chigley soils are on side slopes, and Durant and Wilson soils are on broad flats. Tussy soils have a fine control section, are more than 20 inches thick over bedrock, and occur on side slopes.

Typical pedon of Rayford cobbly loam, 5 to 20 percent slopes, 4,500 feet south, 900 feet east of the northwest corner of sec. 36, T. 1 N., R. 1 W.

A11—0 to 5 inches; dark brown (10YR 4/3) cobbly loam, dark brown (10YR 3/3) moist; moderate fine granular structure; slightly hard, friable; common fine and medium roots; few fine pores; fragments of rounded limestone make up about 30 percent by volume; calcareous; moderately alkaline; gradual smooth boundary.

A12—5 to 12 inches; dark brown (10YR 4/3) very cobbly clay loam, dark brown (10YR 3/3) moist; moderate medium granular structure; slightly hard, friable; few fine and medium roots; few fine pores; fragments of rounded limestone make up about 50 percent by volume; few calcium carbonate bodies; calcareous; moderately alkaline; abrupt smooth boundary.

R—12 to 14 inches; hard limestone conglomerate; tilted 15 degrees from horizontal.

Solum thickness ranges from 8 to 20 inches.

The A11 horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 or 3. Content of limestone fragments ranges from 25 to 35 percent by volume. About 10 to 15 percent by volume is less than 76 millimeters in diameter, and 15 to 25 percent is more than 76 millimeters in diameter. Reaction ranges from neutral to moderately alkaline.

The A12 horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 3 or 4. Texture is cobbly loam, cobbly clay loam, cobbly silty clay loam, very cobbly loam, very cobbly clay loam, or very cobbly silty clay loam. Content of limestone fragments ranges from 45 to 55 percent by volume. About 10 to 20 percent by volume is less than 76 millimeters in diameter, and 25 to 40 percent is more than 76 millimeters in diameter.

The R layer is hard limestone conglomerate. It is tilted less than 20 degrees from the horizontal.

Renfrow Series

The Renfrow series consists of deep, well drained, very slowly permeable, very gently sloping to gently sloping soils on broad to narrow ridge crests and side slopes of uplands. These soils formed in materials weathered from clay or clayey shale under a cover of tall and mid grasses. Slopes range from 1 to 5 percent. The Renfrow series is a member of the fine, mixed, thermic family of Udertic Paleustolls.

Renfrow soils are associated with Bethany, Grainola, Loco, Lucien, Nash, and Zaneis soils. Bethany soils have a mollic epipedon more than 20 inches thick and occur in slightly higher areas. Grainola soils do not have a mollic epipedon, do not have an argillic horizon, have a solum from 20 to 40 inches thick, and occur on slightly lower side slopes. Loco and Lucien soils do not have an argillic horizon, have a loamy control section, have a solum less than 10 inches thick, and occur in lower areas. Nash soils have a coarse-silty control section, do not have an argillic horizon, and occur in lower areas. Zaneis soils have a fine-loamy control section and occur on similar landscapes.

Typical pedon of Renfrow silt loam, 1 to 3 percent slopes, 1,500 feet west and 200 feet north of the southeast corner of sec. 19, T. 4 N., R. 2 W.

A1—0 to 8 inches; dark brown (7.5YR 4/2) silt loam, dark brown (7.5YR 3/2) moist; strong medium granular structure; slightly hard, friable; common fine roots; common pores; slightly acid; clear smooth boundary.

B1—8 to 13 inches; reddish brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) moist; moderate medium subangular blocky structure; hard, firm; many fine roots; common pores; slightly acid; clear smooth boundary.

B21t—13 to 26 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; moderate medium blocky structure; very hard, very firm; common very fine roots; few fine black concretions; clay films on faces of peds; vertical cracks filled with reddish brown (5YR 4/3) silty clay loam; neutral; gradual smooth boundary.

B22t—26 to 40 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; moderate medium and coarse blocky structure; extremely hard, very firm; few fine and very fine roots; few slickensides; distinct clay films on faces of peds; few fine black concretions; few fine powdery bodies of calcium carbonate in lower part; moderately alkaline; gradual smooth boundary.

B3—40 to 61 inches; red (2.5YR 5/6) clay, red (2.5YR 4/6) moist; weak coarse blocky structure; very hard, very firm; few very fine roots; patchy clay films on faces of peds; common soft powdery bodies of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

Cr—61 to 64 inches; red (2.5YR 5/8) clayey shale, red (2.5YR 4/8) moist; massive; calcareous; moderately alkaline.

Solum thickness and depth to bedrock are more than 60 inches.

The A1 horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. Reaction is slightly acid or neutral.

The B1 horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. Texture is silty clay loam or clay loam. Reaction ranges from slightly acid to mildly alkaline.

The B2t horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 3 to 6. Texture is clay or silty clay. Reaction ranges from slightly acid to moderately alkaline.

The B3 horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 6 to 8. Texture is clay, silty clay, or clay loam. Reaction is mildly alkaline or moderately alkaline.

The Cr horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 6 to 8. It is clay or clayey shale.

The Renfrow soils in map units 63 and 64 are taxadjuncts to the Renfrow series because they do not have mollic colors deep enough to be a mollic epipedon. This difference has little effect on use, management, and behavior.

Stephenville Series

The Stephenville series consists of moderately deep, well drained, moderately permeable, very gently sloping to moderately steep soils on broad to narrow ridge crests and on smooth to dissected side slopes of uplands. These soils formed in material weathered from sandstone under a cover of trees with an understory of native grasses. Slopes range from 1 to 20 percent. The Stephenville series is a member of the fine-loamy, siliceous, thermic family of Ultic Haplustalfs.

Stephenville soils are associated with Darnell, Konsil, and Newalla soils. Darnell soils have a solum less than 20 inches thick, do not have an argillic horizon, and occur on slightly higher ridge crests. Konsil soils have a solum more than 40 inches thick and occur on similar landscapes. Newalla soils are on similar landscapes and have a fine-loamy over clayey control section.

Typical pedon of Stephenville fine sandy loam, 3 to 5 percent slopes, 300 feet north and 1,000 feet west of the southeast corner of sec. 19, T. 3 N., R. 4 W.

A1—0 to 5 inches; brown (7.5YR 5/2) fine sandy loam, dark brown (7.5YR 4/2) moist; weak fine granular structure; slightly hard, very friable; many fine and medium roots; slightly acid; clear smooth boundary.

A2—5 to 9 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; weak fine granular structure; slightly hard, very friable; many fine and medium roots; slightly acid; clear smooth boundary.

B21t—9 to 30 inches; red (2.5YR 5/6) sandy clay loam, dark red (2.5YR 3/6) moist; moderate medium subangular blocky structure; hard, firm; common fine roots; common pores; common thin patchy clay films on faces of peds and bridging sand grains; medium acid; gradual smooth boundary.

B22t—30 to 35 inches; red (2.5YR 5/6) sandy clay loam, red (2.5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, firm; few fine roots; common pores; patchy clay films on faces of peds; medium acid; clear smooth boundary.

Cr—35 to 44 inches; light red (2.5YR 6/8) weakly cemented sandstone; slightly acid.

Solum thickness and depth to sandstone range from 20 to 40 inches.

The A1 horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. Texture is fine sandy loam or stony fine sandy loam. Content of coarse fragments of sandstone ranges from 0 to 30 percent by volume. Coarse fragments less than 3 inches in diameter range from 0 to 10 percent by volume, and those more than 3 inches in diameter range from 0 to 20 percent by volume. Reaction ranges from strongly acid to slightly acid.

The A2 horizon has hue of 5YR or 7.5YR, value of 5 or 6, and chroma of 2 to 4. Reaction ranges from strongly acid to slightly acid. In areas thinned by erosion, the A2 and A1 horizons have been mixed by tillage.

The B2t horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 8. Texture is fine sandy loam or sandy clay loam. Reaction is strongly acid or medium acid.

The Cr horizon is light red, red, reddish brown, or reddish yellow weakly cemented sandstone.

Teller Series

The Teller series consists of deep, well drained, moderately permeable, nearly level to sloping soils on broad flats of high stream terraces. These soils formed in material weathered from loamy alluvial sediments under a cover of tall grasses. Slopes range from 0 to 8 percent. The Teller series is a member of the fine-loamy, mixed, thermic family of Udic Argiustolls.

Teller soils are associated with the Norge and Vanoss soils. Norge soils are on higher lying convex ridges and have a fine-silty control section. The Vanoss soils are in slightly lower positions and have a fine-silty control section.

Typical pedon of Teller loam, 0 to 1 percent slopes, 1,800 feet west and 50 feet south of the northeast corner of sec. 9, T. 2 N., R. 1 E.

A1—0 to 12 inches; dark brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; moderate medium granular structure; slightly hard, very friable; many fine roots; medium acid; gradual smooth boundary.

B1—12 to 18 inches; dark brown (7.5YR 4/4) loam, dark brown (7.5YR 3/4) moist; weak medium subangular blocky structure; slightly hard, friable; many fine roots; many pores; medium acid; gradual smooth boundary.

B2t—18 to 40 inches; yellowish red (5YR 4/6) clay loam, yellowish red (5YR 3/6) moist; weak medium subangular blocky structure; hard, firm; common fine roots; common pores; continuous clay films on faces of peds; medium acid; gradual smooth boundary.

B3—40 to 60 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak coarse prismatic structure; hard, friable; few fine roots; medium acid; gradual smooth boundary.

C—60 to 75 inches; reddish yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 5/6) moist; massive; slightly hard, friable; slightly acid.

Solum thickness ranges from 50 to more than 72 inches.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. Texture is loam or fine sandy loam. Reaction ranges from medium acid to neutral.

The B1 horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. Texture is loam. Reaction ranges from medium acid to neutral.

The B2t horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 8. Texture is clay loam or sandy clay loam. Reaction ranges from medium acid to neutral.

The B3 horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 8. Texture is loam or fine sandy loam. Reaction ranges from medium acid to neutral.

The C horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 5 to 8. Texture is loam or fine sandy loam. Reaction ranges from medium acid to neutral. Some pedons are mildly alkaline or moderately alkaline below 70 inches.

The Teller soils in map units 71, 72, and 73 are taxadjuncts to the Teller series because they do not have mollic colors deep enough to be a mollic epipedon. This difference has little effect on their use, management, and behavior.

Tussy Series

In the Tussy series are moderately deep, well drained, very slowly permeable, gently sloping to moderately steep soils on convex ridgetops and side slopes of uplands. These soils formed in material weathered from calcareous red clayey shale under a cover of prairie grasses. Slopes range from 3 to 20 percent. The Tussy series is a member of the fine, montmorillonitic, thermic family of Vertic Ustochrepts.

Tussy soils are associated with Burleson, Chigley, Clarita, Durant, Rayford, and Wilson soils. Burleson and Clarita soils have intersecting slickensides and occur on slightly higher landscapes. Chigley, Durant, and Wilson soils have an argillic horizon and occur in slightly higher areas. In addition, Durant and Rayford soils have a mollic epipedon. Rayford soils have a solum less than 20 inches thick and occur on slightly higher landscapes.

Typical pedon of Tussy clay, 5 to 20 percent slopes, eroded, 3,100 feet west and 150 feet north of the southeast corner of sec. 4, T. 2 N., R. 3 E.

A11—0 to 4 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; strong coarse granular structure; hard, firm; many fine roots; cracks 5 to 10 millimeters wide; few angular chert fragments less than 76 millimeters in diameter; about 10 percent by volume soft bodies and concretions of calcium carbonate 2 to 10 millimeters in diameter; calcareous; mildly alkaline; gradual smooth boundary.

A12—4 to 8 inches; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; strong coarse subangular blocky structure; hard, firm; few fine roots; cracks 5 to 10 millimeters wide; about 15 percent by volume soft bodies and concretions of calcium carbonate 5 to 10 millimeters in diameter; calcareous; moderately alkaline; gradual smooth boundary.

B2—8 to 32 inches; reddish brown (2.5YR 5/4) silty clay, reddish brown (2.5YR 4/4) moist; moderate medium subangular blocky structure; hard, firm; few fine roots; cracks 5 to 10 millimeters wide; about 30 percent by volume soft bodies and concretions of calcium carbonate 5 to 15 millimeters in diameter; calcareous; moderately alkaline; gradual irregular boundary.

C—32 to 60 inches; reddish brown (5YR 5/4) and pale olive (5Y 6/3) silty clay loam; massive; 60 percent by volume soft bodies and concretions of calcium carbonate 2 to 35 millimeters in diameter; calcareous; moderately alkaline.

Solum thickness ranges from 20 to 40 inches. This soil cracks during the summer months. The cracks in the A and B2ca horizons are 5 to 15 millimeters wide and at least 20 inches in length at a depth of 20 inches. This soil has a potential linear extensibility of more than 60 and coefficient of linear extensibility of 0.07 or more.

The A horizon has hue of 2.5YR to 7.5YR, value of 3 to 5, and chroma of 2 to 6. Texture is clay, silty clay loam, or clay loam. Coarse fragments less than 76 millimeters in diameter range from 0 to 20 percent by volume. Reaction is mildly alkaline or moderately alkaline.

The B2 horizon has hue of 10R to 5YR, value of 3 to 5, and chroma of 3 to 6. Texture is clay or silty clay with a clay content that ranges from 40 to 50 percent. Soft bodies and concretions of calcium carbonate range from 10 to 50 percent by volume. Concretions of calcium carbonate less than 76 millimeters in diameter range from 0 to 10 percent by volume, and those more than 76 millimeters in diameter range from 0 to 2 percent by volume. Soft bodies of calcium carbonate range from 10 to 40 percent by volume. Slickensides range from none to common.

The C horizon has hue of 10R to 5Y, value of 3 to 6, and chroma of 3 to 8. Texture is silty clay loam, clay, or shaly clay. Soft bodies and concretions of calcium carbonate range from 25 to 75 percent by volume. Concretions of calcium carbonate less than 76 millimeters in diameter range from 10 to 35 percent by volume, and those more than 76 millimeters in diameter range from 5 to 15 percent by volume. Soft bodies of calcium carbonate range from 10 to 30 percent by volume.

Vanoss Series

The Vanoss series consists of deep, well drained, moderately permeable, very gently sloping soils on high stream terraces of uplands. These soils formed in loamy sediments under a cover of tall grasses. Slopes range from 1 to 3 percent. The Vanoss series is a member of the fine-silty, mixed, thermic family of Udic Argiustolls.

Vanoss soils are associated with the Norge and Teller soils. Norge and Teller soils are on slightly higher positions. Norge soils have hue of 5YR or redder in the B2t horizon and do not decrease in clay content within 60 inches of the soil surface. Teller soils have a fine-loamy control section.

Typical pedon of Vanoss loam, 1 to 3 percent slopes, 2,490 feet west and 2,340 feet north of the southeast corner of sec. 35, T. 4 N., R. 1 W.

Ap—0 to 8 inches; dark brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; moderate medium and fine granular structure; slightly hard, friable; many fine roots; slightly acid; gradual smooth boundary.

A1—8 to 12 inches; dark brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure parting to medium and fine granular; slightly hard, friable; many fine roots; slightly acid; gradual smooth boundary.

B1—12 to 24 inches; brown (7.5YR 5/3) silty clay loam, dark brown (7.5YR 4/3) moist; moderate medium subangular blocky structure; hard, friable; many fine roots; many pores; clay films on faces of peds; slightly acid; gradual smooth boundary.

B2t—24 to 44 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable; common fine roots; common pores; clay films on faces of peds; neutral; gradual smooth boundary.

B3—44 to 58 inches; strong brown (7.5YR 5/6) silty clay loam, strong brown (7.5YR 4/6) moist; weak coarse blocky structure; hard, friable; few fine roots; few pores; patchy clay films on faces of peds; few calcium carbonate concretions; few soft bodies of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

C—58 to 64 inches; yellowish red (5YR 5/6) silt loam, yellowish red (5YR 4/6) moist; massive; slightly hard, friable; moderately alkaline.

Solum thickness ranges from 40 to more than 60 inches. The mollic epipedon is less than 20 inches thick.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 or 3. Reaction is slightly acid to neutral.

The B1 horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 to 4. Texture is loam, silty clay loam, or clay loam. Reaction is medium acid to neutral.

The B2t horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. Texture is silty clay loam or clay loam. Reaction is medium acid to neutral.

The B3 horizon has hue of 5YR to 10YR, value of 4 to 6, and chroma of 3 to 8. Texture is silt loam or silty clay loam. Reaction is slightly acid to moderately alkaline.

The C horizon has colors similar to those of the B3 horizon. Texture is loam or silt loam. Reaction is neutral to moderately alkaline.

Wilson Series

The Wilson series consists of deep, somewhat poorly drained, very slowly permeable, nearly level soils on smooth uplands. These soils formed in material weathered from clayey sediments. A perched water table is within a depth of 2 feet during the winter and spring. Slopes are 0 to 1 percent. The Wilson series is a member of the fine, montmorillonitic, thermic family of Vertic Ochraqualfs.

Wilson soils are associated with Burleson, Chigley, Clarita, Durant, Rayford, and Tussy soils. Burleson soils occur on similar landscapes and do not have an argillic horizon. Chigley soils, which occur on slightly lower landscapes, do not have wetness mottles within 2 feet of the soil surface. Clarita soils occur on slightly lower landscapes than Wilson soils and do not have an argillic horizon. Durant soils occur in slightly higher areas and have a mollic epipedon. Rayford and Tussy soils, which occur on slightly lower side slopes, have a solum less than 20 inches thick. In addition, Rayford soils have a loamy control section.

Typical pedon of Wilson silt loam, 0 to 1 percent slopes, 2,140 feet south and 2,610 feet west of the northeast corner of sec. 12, T. 4 N., R. 3 E.

A1—0 to 8 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak fine granular structure; massive when dry; hard, friable; slightly acid; abrupt wavy boundary.

B21tg—8 to 24 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) dry; moderate medium blocky structure; very hard, extremely firm; few fine roots; clay films on faces of peds; vertical cracks partly filled with gray silt loam; slightly acid; gradual smooth boundary.

B22tg—24 to 40 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; few medium and fine prominent strong brown (7.5YR 5/6) mottles; weak medium blocky structure; extremely hard, extremely firm; few fine roots; clay films on faces of peds; moderately alkaline; gradual smooth boundary.

B3g—40 to 50 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; common fine and medium distinct strong brown (7.5YR 5/6) mottles; weak coarse blocky structure; extremely hard, extremely firm; few very fine roots; few black concretions; moderately alkaline; clear smooth boundary.

C—50 to 60 inches; coarsely mottled gray (10YR 5/1) and brown (7.5YR 5/2) clay; massive; few lime concretions; moderately alkaline.

Depth to bedrock is more than 60 inches. Thickness of the solum is 40 to more than 60 inches.

The A horizon has hue of 10YR, value of 3 to 5, and chroma of 1 or 2. Reaction is medium acid or slightly acid.

The B2tg horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. A low-chroma matrix with high-chroma mottles occurs at less than 40 inches below the surface. Texture of the B2tg horizon is clay but may range to silty clay in the upper 10 inches. Reaction is slightly acid to moderately alkaline in the upper part and neutral to moderately alkaline in the lower part.

The B3g horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 0 to 2. Reaction is neutral to moderately alkaline. In some pedons, this horizon has crystals of gypsum.

The C horizon has hue of 10YR to 5Y, value of 5 or 6, and chroma of 1 to 6. Some pedons are mottled with two or more colors in shades of brown, gray, yellow, or olive.

Yahola Series

The Yahola series consists of deep, well drained, moderately rapidly permeable, nearly level soils on broad flood plains of the Washita River. These soils formed in predominantly loamy calcareous sediments under a cover of tall and mid grasses with hardwood trees. Slopes range from 0 to 1 percent. The Yahola series is a member of the coarse-loamy, mixed (calcareous), thermic family of Typic Ustifluvents.

The Yahola soils are associated with Asa, Bergstrom, Elandco, Gaddy, Garvin, Gracemont, Port, and Pulaski soils. Asa, Bergstrom, Elandco, and Port soils occur on similar landscapes, have a mollic epipedon, and have a fine-silty control section. Gaddy soils occur in slightly higher convex areas and have a sandy control section. Garvin soils occur on similar landscapes, have a mollic epipedon, and have a fine control section. Gracemont soils occur in slightly lower concave areas and have a water table above a depth of 40 inches during the winter and spring. Pulaski soils occur on similar landscapes and are noncalcareous throughout the control section.

Typical pedon of Yahola fine sandy loam, occasionally flooded, 3,900 feet south and 1,500 feet west of the northeast corner of sec. 25, T. 4 N., R. 1 W.

A—0 to 12 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak fine granular structure; slightly hard, very friable; many fine roots; calcareous; moderately alkaline; gradual smooth boundary.

C1—12 to 42 inches; reddish yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 4/6) moist; massive; slightly hard, very friable; few fine roots; thin strata of coarser and finer materials; calcareous; moderately alkaline; gradual smooth boundary.

C2—42 to 63 inches; reddish yellow (5YR 6/6) loamy fine sand, yellowish red (5YR 5/6) moist; massive; soft, friable; thin strata of fine sandy loam; calcareous; moderately alkaline.

Depth to bedrock is more than 60 inches. Reaction is mildly alkaline or moderately alkaline. Some pedons are not calcareous in the upper 10 inches.

The A horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 3 to 6.

The C horizon has hue of 2.5YR to 7.5YR, value of 5 to 7, and chroma of 4 to 8. Texture ranges from loamy fine sand to loam but averages fine sandy loam in the 10- to 40-inch control section.

Zaneis Series

The Zaneis series consists of deep, well drained, moderately slowly permeable soils on broad ridgetops and side slopes of uplands. These very gently sloping to gently sloping soils formed in material weathered from weakly consolidated sandstone and sandy shale under a cover of tall and mid grasses. Slopes range from 1 to 5 percent. The Zaneis series is a member of the fine-loamy, mixed, thermic family of Udic Argiustolls.

The Zaneis soils are associated with Bethany, Grainola, Loco, Lucien, Nash, and Renfrow soils. Bethany and Renfrow soils occur on slightly higher landscapes and have a fine control section. Grainola soils are slightly lower, do not have a mollic epipedon, and have a fine control section. Loco, Lucien, and Nash soils usually occur on slightly lower landscapes and do not have an argillic horizon.

Typical pedon of Zaneis loam, 3 to 5 percent slopes, 300 feet north and 2,500 feet west of the southeast corner of sec. 23, T. 3 N., R. 3 W.

A1—0 to 10 inches; reddish brown (5YR 5/3) loam, dark reddish brown (5YR 3/3) moist; moderate medium granular structure; slightly hard, friable; many fine roots; neutral; gradual smooth boundary.

B1—10 to 18 inches; reddish brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; weak medium subangular blocky structure; hard, friable; many fine roots; common pores; few fine black concretions; slightly acid; gradual smooth boundary.

B21t—18 to 38 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; hard, firm; common fine roots; common pores; clay films on faces of peds; common medium and fine black concretions; slightly acid; gradual smooth boundary.

B22t—38 to 51 inches; red (2.5YR 5/6) clay loam, red (2.5YR 4/6) moist; moderate medium subangular blocky structure; hard, firm; few fine roots; clay films on faces of peds; common medium and fine black concretions; neutral; gradual smooth boundary.

B3—51 to 57 inches; light red (2.5YR 6/6) clay loam, red (2.5YR 5/6) moist; weak medium and coarse subangular blocky structure; hard, firm; few very fine roots; patchy clay films on faces of peds; neutral; gradual smooth boundary.

Cr—57 to 62 inches; light red (2.5YR 6/6) sandy shale, red (2.5YR 5/6) moist; neutral.

Thickness of the solum and depth to bedrock range from 40 to 60 inches.

The A horizon has hue of 5YR to 10YR, value of 3 to 5, and chroma of 2 or 3. Reaction ranges from medium acid to neutral.

The B1 horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. Texture is loam or clay loam. Reaction ranges from medium acid to neutral.

The B2t horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 4 to 8. Texture is clay loam or sandy clay loam. Reaction ranges from medium acid to neutral.

The B3 horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 8. Texture is clay loam or sandy clay loam. Reaction ranges from slightly acid to mildly alkaline.

The Cr horizon has color similar to that of the B3 horizon. It consists of alternating layers of weakly consolidated sandstone and sandy shale. Reaction ranges from slightly acid to mildly alkaline.

The Zaneis soils in map unit 89 are taxadjuncts to the Zaneis series because they do not have mollic colors deep enough to be a mollic epipedon. This difference has little effect on their use, management, and behavior.

Formation of the Soils

This section describes the major factors of soil formation, the processes of soil formation, and the geology of the county.

Factors of Soil Formation

Soil is the product of five major factors—parent material, climate, plants and animals, relief, and time. If one factor, vegetation for example, differs from one area to another, the soils that form in the two areas will differ.

Parent Material

Soils form in unconsolidated material that influences the rate at which the soil forms; the chemical, physical, and mineral composition of the soils; and the color of the soils.

Soils on the uplands of Garvin County formed in material weathered from sandstone, clay, and shale. Stephenville, Lucien, Nash, and Zaneis soils are examples of soils that formed in materials weathered from sandstone. Renfrow, Grainola, and Newalla soils formed in material weathered from shale.

Alluvial sediment is extensive along the streams and rivers of the county. The kind of sediment deposited depends largely on the source of the sediment and the velocity of the floodwater that deposited it. Elandco and Port soils formed in loamy sediment deposited along streams when the streams overflowed. Garvin and Lela soils formed in clayey sediment deposited by narrow streams carrying large amounts of clay-sized particles. Pulaski and Yahola soils formed in sandy sediment deposited by fast-moving water near the stream channel.

Climate

The moist, subhumid continental climate of Garvin County is characterized by high-intensity rainfall. Moisture and warm temperatures have promoted the formation of distinct horizons in many of the soils. Differences between the soils cannot be attributed to climate, however, because the climate has been uniform throughout the county. Heavy rains have caused rapid runoff that has eroded many of the soils. The erosion is an indirect effect of climate.

Plant and Animal Life

Plants, burrowing animals, insects, and soil micro-organisms have a direct influence on the formation of soils. The native grasses and trees in the county have had different effects on the losses and gains of organic matter and plant nutrients and on the soil structure and porosity. Bethany soils developed under prairie vegetation and have a dark grayish brown surface layer and a moderately high content of organic matter. Stephenville and Newalla soils developed under forest vegetation and have a brown surface layer and a low content of organic matter.

Relief

Relief influences the formation of the soils mainly through its effect on water movement, erosion, soil temperature, and the kind of plant cover. In Garvin County, relief is determined largely by the resistance of underlying formations to weathering and geological erosion. About 24 percent of the acreage in Garvin County is nearly level soils on flood plains, and about 76 percent is nearly level to steep soils on uplands.

Zaneis and Lucien soils formed in similar sandstone parent material. Their development, however, was controlled to a large extent by relief. The deep Zaneis soils are less sloping than the shallow Lucien soils.

Time

As a factor in soil formation, the effect of time cannot be measured strictly in years. The length of time needed for development of genetic horizons depends on the intensity and the interactions of the other soil-forming factors in promoting the losses, gains, transfers, and transformations necessary to form soil horizons. Soils that have no definite genetic horizons are young, or immature. Mature, or older, soils have approached equilibrium with their environment and tend to have well-defined horizons.

The soils in Garvin County range from young to old. Renfrow and Bethany soils are examples of old soils on uplands. Teller and Konawa soils are younger but they have well-expressed horizons. Lucien soils, which are considered young, have had sufficient time to develop well-expressed horizons, but because they are sloping geological erosion takes away soil material almost as fast as it forms. Pulaski and Yahola soils are young. They formed in recent sediment on flood plains and show little horizon development.

Processes of Soil Formation

Active processes that have influenced the formation of horizons in the soils of Garvin County are accumulation of organic matter, leaching of calcium carbonates and bases, and translocation of silicate clay minerals. In most soils, more than one process has been active.

The addition of organic matter to the surface layer by native grasses contributes to granular structure. The surface layer is high in content of organic matter in soils such as the Bethany soils and is called a *mollic epipedon* in the soil classification system. Konawa soils formed under trees and contain less organic matter than Bethany soils; their surface layer is called an *ochric epipedon* in the classification system.

Leaching of carbonates and bases is an active process in the formation of soils. The accumulation of calcium carbonates and bases in the lower part of the B horizon of Bethany soils indicates the depth to which water has percolated. Leaching has been so active in the Konawa soils that they have no accumulation of calcium carbonates. More bases have been leached from the B horizon of these soils, and this is reflected by their base saturation. Soils on flood plains, such as Gracemont soils, are recharged with bases when flooding occurs. The more acid Pulaski soils have not been leached, but they receive sediments from neutral to acid soils. Clarita soils formed over weathered shale beds and clayey sediments and are high in carbonates. Calcium carbonates in Clarita soils are related to the nature of the parent materials.

The translocation of silicate clay minerals is a very important factor to scientists in establishing the properties and classifying the soils. Clay films on the ped surfaces, clay bridging the sand grains, and an increase in the total clay are evidence of argillic horizons. Many soils, including Renfrow and Zaneis soils, have an argillic horizon. The varying degrees of translocation of silicate clay minerals and the nature of the parent material have resulted in wide variations in the texture and other properties of the argillic horizon in different soils. Konawa and Konsil soils have a subsurface layer that is more intensely leached of silicate clay minerals than the surface layer of other soils in the county.

Grasses bring bases to the surface, and this retards leaching and the formation of an A2 horizon. Through soil losses, geological erosion has hindered horizon development on soils such as Lucien soils. The sediment on Gaddy and Yahola soils and other soils on flood plains was deposited so recently that there has not been enough time for the formation of horizons.

Geology of the County

Kenneth S. Johnson, Oklahoma Geological Survey, University of Oklahoma, helped prepare this section.

The geology of Garvin County is fairly simple. Outcropping rocks consist of sandstones, shales, and conglomerates that were deposited near the shores of shallow seas that once covered much of what is now western Oklahoma, and in many places these sedimentary rocks are mantled by unconsolidated alluvium laid down by present-day rivers and streams. These outcropping strata overlie additional sedimentary rocks that are important sources of oil and natural gas.

Subsurface rock units of sedimentary origin in Garvin County are about 7,000 feet thick in the eastern part of the county and are more than 20,000 feet thick in the west, where they thicken markedly into the famous Anadarko Basin. These subsurface sedimentary rocks were deposited in great, shallow seas that covered much of southern Oklahoma intermittently from Cambrian time (about 525 million years ago) until the beginning of Pennsylvanian time (about 320 million years ago). These rocks were then thrust upward and were folded and faulted, forming the Arbuckle Mountains several miles to the south in Murray County. With the uplift and erosion of the Arbuckle Mountains during the Pennsylvanian Period (320 to 275 million years ago) a great flood of gravels, sands, and clays spread northward and northwestward across what is now Garvin County. These sediments make up the bulk of the sedimentary rocks below the surface, particularly in the western half of the county.

At the end of the Pennsylvanian Period and during the early part of the Permian Period (275 to about 250 million years ago) the outcropping rocks of Garvin County were laid down. Sands, gravels, and clays were eroded from lowland areas of eastern Oklahoma and from the nearby Arbuckle Mountains, which, by this time, had been reduced to low hills. During the Permian Period, the area that is now Garvin County was close to, or at the shoreline of, a large inland sea that covered what is now western Oklahoma and the adjacent states. Thus the county was the site for deposition of interbedded sandstones, conglomerates, and shales; this type of deposition reflects sedimentation in alternating river, delta, and shallow-sea environments. At the present time, these sedimentary rocks dip gently to the west across the county at an angle of less than 1 degree. The oldest rocks are exposed in the east, and these are overlain by successively younger Permian strata to the west (fig. 18).

Because the soils in most areas result from the weathering and disaggregation of outcropping rock units, there is a close relationship between the character of these rock formations and the soils that develop upon them. Thus a description of the geology of outcropping

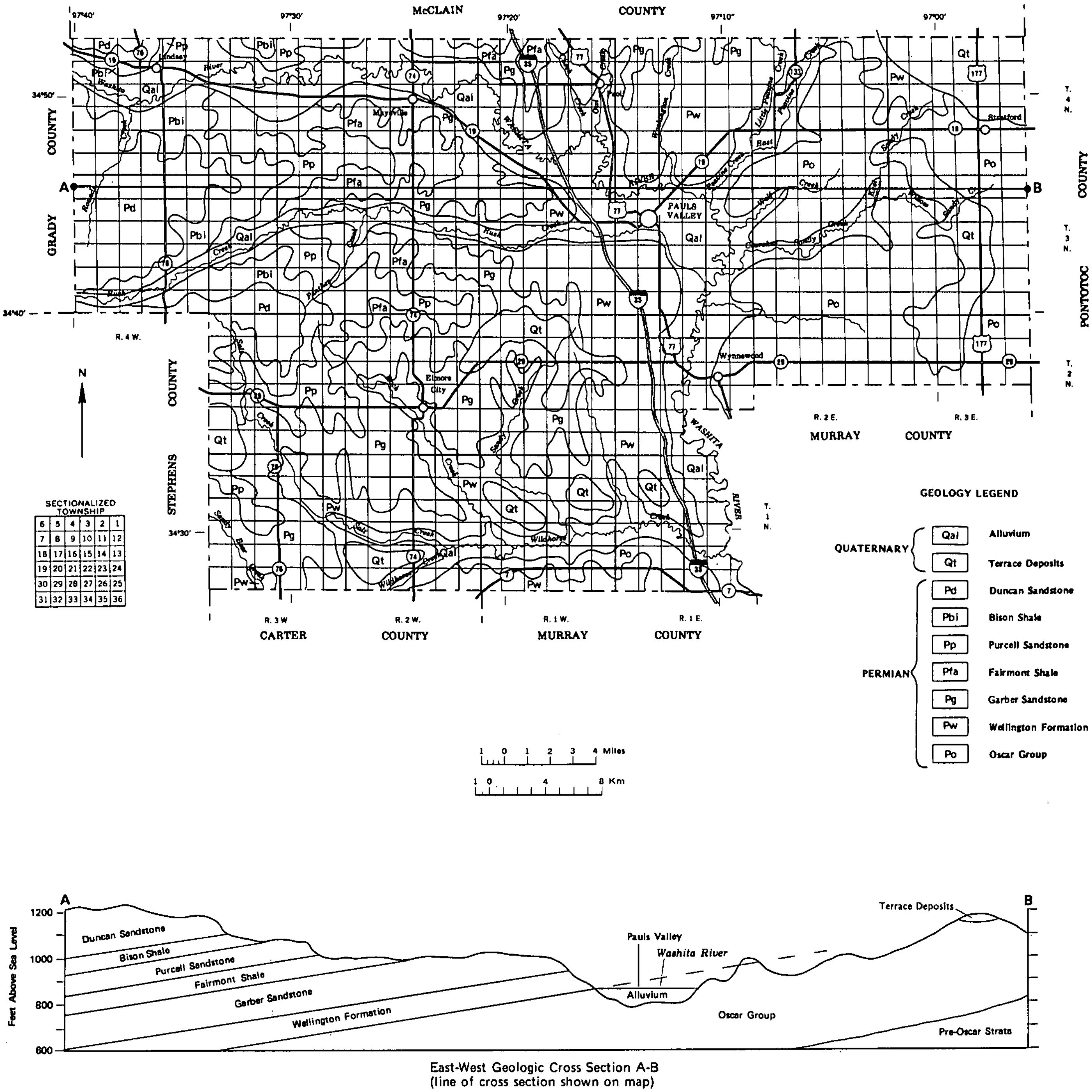

Figure 18.—General geology of Garvin County, Oklahoma. (Modified from Hart, 1974.)

rock units in the county will help explain the distribution of the soils in the county.

The oldest rock unit exposed in Garvin County is the Oscar Group (fig. 18). It consists chiefly of reddish brown to gray shale, but it also contains some sandstone and conglomerate beds. The full thickness of the Oscar Group ranges from about 300 to 500 feet. Soils that have developed on almost all areas underlain by the Oscar Group consist of soils of the Clarita-Durant and the Chigley general soil map units, which are loamy and clayey soils of low permeability that develop on shales or cherty conglomerates.

Overlying the Oscar Group is the Wellington Formation, which consists of reddish brown shale 100 to 200 feet thick with several sandstone beds. Most Wellington outcrops are covered with soils of the Renfrow-Zaneis general soil map unit, although some outcrops are overlain by the soils of the Grainola-Lucien and Stephenville-Newalla general soil map units. South of Wildhorse Creek the Wellington is mantled by soils of the Clarita-Durant general soil map unit. These are loamy or clayey soils that typically develop on shales or on shales interbedded with siltstones or sandstones.

The overlying Garber Sandstone, which consists of reddish brown sandstone about 150 feet thick, is in turn overlain by the Fairmont Shale, which consists of reddish brown shale 40 to 80 feet thick (fig. 18). Both these formations are typically mantled by soils of the Renfrow-Zaneis and Stephenville-Newalla general soil map units. These are loamy soils that can develop on sandstone or shale bedrock.

Overlying the Fairmont Shale are the Purcell Sandstone and the Bison Shale. The Purcell is reddish brown, maroon, and greenish-gray sandstone 90 to 150 feet thick with some interbeds of reddish brown shale; the Bison consists of gray and reddish brown shale 50 to 90 feet thick. Both the Purcell and Bison formations are typically covered by soils of the Lucien-Grainola and Renfrow-Zaneis groups, which are loamy soils that form on shales, siltstones, or sandstones.

The youngest bedrock unit in Garvin County is the Duncan Sandstone, which crops out in the western part of the county (fig. 18). The Duncan consists of white to buff-colored sandstone several hundred feet thick with interbeds of mudstone, conglomerate, and siltstone. Almost all outcrops of the Duncan are mantled with soils of the Stephenville-Newalla general soil map unit that are loamy and have developed on sandstone or shale.

Quaternary alluvial and terrace deposits of Garvin County generally are 10 to 100 feet thick and consist mainly of sand, clay, and gravel eroded from outcropping Permian strata within, and to the west of, the county. Quaternary sediments, all deposited within the past million years or so, were laid down mainly as flood plain or alluvial deposits along major rivers and streams flowing to the east and southeast across the county. Terrace deposits, which consist of older alluvium left behind after a river shifts position or cuts deeply into underlying rocks, occur mainly on sloping uplands adjacent to flood plains; some terraces, however, occur well above present-day rivers, such as those in the northeastern part of the county or in scattered localities 1 to 2 miles north of Wildhorse Creek. Terrace deposits in the county typically are covered by soils of the Teller-Norge and Konawa-Konsil general soil map units. Alluvial deposits in stream channels or flood plains of present-day rivers and streams are mantled by loamy soils of the Keokuk-Yahola-Dale and Port-Garvin-Pulaski general soil map units.

The mineral and water resources of Garvin County are important to the overall development and progress of the county. Petroleum production is by far the most important mineral activity: production in the county during 1980 amounted to about 8.4 million barrels of crude oil and about 27 billion cubic feet of natural gas, thus ranking Garvin County in the top 10 percent of the petroleum-producing counties in the state. A small quantity of copper was mined from a small deposit east of Paoli many years ago, and there has been occasional renewed interest in this and similar small deposits in the county whenever the price of copper rises markedly. Sand and gravel resources are present in some of the alluvial and terrace deposits of the county, and small deposits of asphaltic sandstone and volcanic ash are present at several sites in the county. Good-quality ground water occurs in the Oscar Group aquifer in the southwestern part of the county, and similar water resources occur in some of the sand and gravel aquifers of the Quaternary alluvium and terrace deposits that are widespread in the county (*3*).

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) Hart, D. L., Jr. 1974. Reconnaissance of the water resources of the Ardmore and Sherman Quadrangles, southern Oklahoma. Okla. Geol. Surv. Hydrol. Atlas HA-3, scale 1:250,000.

(4) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplements replacing pp. 173-188 issued May 1962.]

(5) United States Department of Agriculture. 1972. Soil survey laboratory methods and procedures for collecting soil samples. Soil Surv. Invest. Rep. 1, 63 pp., illus.

(6) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

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 (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

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.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax 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. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 t— 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. 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 that part of the soil profile between depths of 10 inches and 40 or 80 inches.

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 (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for 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 they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excessive silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

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 (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional 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.

Forb. Any herbaceous plant not a grass or a sedge.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai. Commonly a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of Vertisols—clayey soils having a high coefficient of expansion and contraction with changes in moisture content.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual.* The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, alluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Arabic numeral 2 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.

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.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants 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.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

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 simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	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

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

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-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.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface 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.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind 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. Breaking up a compact subsoil by pulling a special chisel through the soil.

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 precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

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 soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Based on data recorded in the period 1951-77 at Pauls Valley, Oklahoma]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have--		Average number of growing degree days*	Average	2 years in 10 will have--		Average number of days with 0.10 inch or more	Average snowfall
				Maximum temperature higher than--	Minimum temperature lower than--			Less than--	More than--		
	°F	°F	°F	°F	°F		In	In	In		In
January----	51.9	27.6	39.8	77	2	21	1.29	.25	2.09	3	2.5
February---	58.1	32.2	45.2	82	11	52	1.46	.68	2.10	4	1.8
March------	65.7	39.6	52.6	91	16	192	2.30	.97	3.37	5	1.1
April------	75.9	50.7	63.3	94	27	399	3.52	1.72	4.98	6	.0
May--------	83.1	59.3	71.2	97	40	657	5.22	2.54	7.41	7	.0
June-------	91.2	67.7	79.5	102	51	885	3.18	1.37	4.64	5	.0
July-------	96.3	71.5	83.9	107	57	1,051	2.46	.99	3.65	4	.0
August-----	96.1	70.0	83.1	107	57	1,026	2.46	.81	3.77	4	.0
September--	88.0	62.7	75.4	103	42	762	3.85	1.27	5.92	5	.0
October----	77.5	51.0	64.3	95	30	443	3.72	.96	5.92	5	.0
November---	64.0	38.9	51.4	84	17	127	2.07	.53	3.31	4	.3
December---	54.4	30.8	42.6	77	7	21	1.72	.58	2.63	3	2.2
Year-----	75.2	50.2	62.7	109	0	5,636	33.25	25.77	40.73	55	7.9

*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° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Based on data recorded in the period 1951-77 at Pauls Valley, Oklahoma]

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--	March 30	April 8	April 16
2 years in 10 later than--	March 24	April 3	April 12
5 years in 10 later than--	March 12	March 25	April 4
First freezing temperature in fall:			
1 year in 10 earlier than--	November 5	October 25	October 16
2 years in 10 earlier than--	November 11	October 30	October 22
5 years in 10 earlier than--	November 23	November 9	October 31

TABLE 3.--GROWING SEASON

[Based on data recorded in the period 1951-77 at Pauls Valley, Oklahoma]

Probability	Length of growing season if daily minimum temperature is---		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	228	210	191
8 years in 10	237	216	198
5 years in 10	255	229	209
2 years in 10	273	241	221
1 year in 10	283	247	227

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1	Amber very fine sandy loam, 1 to 3 percent slopes, rarely flooded	1,967	0.4
2	Asa silty clay loam, occasionally flooded	1,073	0.2
3	Asher silty clay loam, rarely flooded	7,538	1.5
4	Asher-Urban land complex, rarely flooded	229	*
5	Bergstrom silt loam, occasionally flooded	2,712	0.5
6	Bethany silt loam, 0 to 1 percent slopes	2,145	0.4
7	Bethany silt loam, 1 to 3 percent slopes	8,053	1.5
8	Burleson clay, 1 to 3 percent slopes	1,249	0.2
9	Chigley gravelly sandy loam, 1 to 5 percent slopes	12,075	2.3
10	Chigley gravelly sandy loam, 5 to 12 percent slopes	8,294	1.6
11	Chigley and Clarita soils, 2 to 8 percent slopes, gullied	7,626	1.5
12	Clarita clay, 2 to 5 percent slopes	4,386	0.8
13	Clarita clay, 3 to 5 percent slopes, eroded	16,569	3.2
14	Clarita clay, 5 to 12 percent slopes, eroded	20,494	3.9
15	Dale silt loam, rarely flooded	10,061	1.9
16	Dale-Urban land complex, rarely flooded	582	0.1
17	Durant loam, 0 to 1 percent slopes	2,676	0.5
18	Durant loam, 1 to 3 percent slopes	7,015	1.3
19	Durant loam, 2 to 5 percent slopes, eroded	6,291	1.2
20	Durant clay loam, 2 to 5 percent slopes, gullied	957	0.2
21	Elandco silty clay loam, occasionally flooded	392	0.1
22	Galey loamy fine sand, 1 to 3 percent slopes	1,003	0.2
23	Garvin silty clay loam, occasionally flooded	14,998	2.9
24	Garvin and Elandco soils, frequently flooded	8,230	1.6
25	Gracemont fine sandy loam, occasionally flooded	5,195	1.0
26	Grainola clay loam, 2 to 5 percent slopes	4,701	0.9
27	Grainola clay loam, 5 to 20 percent slopes	16,306	3.1
28	Grainola cobbly clay loam, 5 to 20 percent slopes, eroded	729	0.1
29	Grainola-Urban land complex, 2 to 8 percent slopes	201	*
30	Justin loam, 0 to 1 percent slopes	1,261	0.2
31	Justin loam, 1 to 3 percent slopes	1,444	0.3
32	Keokuk silt loam, rarely flooded	13,802	2.7
33	Keokuk-Urban land complex, rarely flooded	541	0.1
34	Konawa loamy fine sand, 3 to 8 percent slopes	1,758	0.3
35	Konawa loamy fine sand, 3 to 8 percent slopes, eroded	1,568	0.3
36	Konawa loamy fine sand, 3 to 8 percent slopes, gullied	2,056	0.4
37	Konawa loamy fine sand, 8 to 20 percent slopes	534	0.1
38	Konawa fine sandy loam, 1 to 3 percent slopes	1,494	0.3
39	Konawa fine sandy loam, 2 to 5 percent slopes, eroded	3,646	0.7
40	Konawa fine sandy loam, 5 to 8 percent slopes	639	0.1
41	Konsil loamy fine sand, 0 to 3 percent slopes	3,850	0.7
42	Konsil loamy fine sand, 3 to 8 percent slopes	4,424	0.9
43	Konsil loamy fine sand, 2 to 8 percent slopes, gullied	899	0.2
44	Lela clay, rarely flooded	5,152	1.0
45	Loco silty clay loam, 3 to 8 percent slopes	1,891	0.4
46	Lucien stony loam, 12 to 30 percent slopes	6,246	1.2
47	Lucien-Nash complex, 5 to 12 percent slopes	8,724	1.7
48	McLain silty clay loam, rarely flooded	5,088	1.0
49	McLain-Urban land complex, rarely flooded	141	*
50	Newalla fine sandy loam, 1 to 3 percent slopes	4,495	0.9
51	Newalla fine sandy loam, 3 to 5 percent slopes	4,795	0.9
52	Newalla fine sandy loam, 2 to 5 percent slopes, eroded	5,249	1.0
53	Norge silt loam, 0 to 1 percent slopes	905	0.2
54	Norge silt loam, 1 to 3 percent slopes	2,911	0.6
55	Oil-wasteland	324	0.1
56	Port fine sandy loam, overwash, occasionally flooded	7,260	1.4
57	Port silt loam, occasionally flooded	15,555	3.0
58	Port and Pulaski soils, frequently flooded	10,322	2.0
59	Pulaski fine sandy loam, occasionally flooded	5,372	1.1
60	Rayford cobbly loam, 5 to 20 percent slopes	255	*
61	Renfrow silt loam, 1 to 3 percent slopes	8,362	1.6
62	Renfrow silt loam, 3 to 5 percent slopes	4,247	0.8
63	Renfrow silt loam, 2 to 5 percent slopes, eroded	30,280	5.8
64	Renfrow silt loam, 2 to 5 percent slopes, gullied	12,379	2.4
65	Renfrow-Urban land complex, 1 to 5 percent slopes	262	0.1
66	Stephenville fine sandy loam, 1 to 3 percent slopes	3,114	0.6

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
67	Stephenville fine sandy loam, 3 to 5 percent slopes	17,142	3.3
68	Stephenville fine sandy loam, 2 to 5 percent slopes, eroded	14,982	2.9
69	Stephenville-Darnell complex, 5 to 20 percent slopes	20,857	4.0
70	Stephenville and Newalla soils, 2 to 8 percent slopes, gullied	16,552	3.2
71	Teller fine sandy loam, 2 to 5 percent slopes, eroded	17,502	3.4
72	Teller fine sandy loam, 5 to 8 percent slopes, eroded	3,279	0.6
73	Teller fine sandy loam, 2 to 8 percent slopes, gullied	2,242	0.4
74	Teller loam, 0 to 1 percent slopes	1,904	0.4
75	Teller loam, 1 to 3 percent slopes	5,409	1.0
76	Teller loam, 3 to 5 percent slopes	1,926	0.4
78	Teller-Urban land complex, 0 to 5 percent slopes	1,243	0.2
79	Tussy clay, 3 to 5 percent slopes	924	0.2
80	Tussy clay, 5 to 20 percent slopes, eroded	3,454	0.7
81	Urban land	242	*
82	Vanoss loam, 1 to 3 percent slopes	784	0.2
83	Wilson silt loam, 0 to 1 percent slopes	1,423	0.3
84	Yahola fine sandy loam, occasionally flooded	11,083	2.1
85	Yahola-Gaddy complex, frequently flooded	7,966	1.5
86	Zaneis loam, 1 to 3 percent slopes	6,458	1.2
87	Zaneis loam, 3 to 5 percent slopes	4,904	0.9
88	Zaneis loam, 2 to 5 percent slopes, eroded	19,132	3.7
89	Zaneis loam, 2 to 5 percent slopes, gullied	5,920	1.1
	Water	640	0.1
	Total	520,960	100.0

* Less than 0.1 percent.

TABLE 5.--ANNUAL GRAZING YIELDS

[Yields are estimated for a high level of management. Absence of a yield figure indicates the crop or grass is seldom grown or is not suited]

Map symbol and soil name	Animal-unit-months (AUM*) per acre						
	Improved bermuda-grass	Weeping lovegrass	King Ranch bluestem	Tall fescue	Forage sorghum	Small grain grazeout	Caucasian or plains bluestem
1. Amber	7.5	7.0	5.0	---	3.0	3.5	7.5
2. Asa	8.0	---	---	---	3.4	4.0	---
3. Asher	7.5	7.0	---	5.0	3.4	4.0	---
5. Bergstrom	4.5	---	4.0	---	3.4	4.0	5.0
6. Bethany	7.0	6.0	7.0	---	3.0	3.8	8.0
7. Bethany	6.5	6.0	6.5	---	3.0	3.5	7.5
8. Burleson	4.5	---	4.0	4.5	3.4	4.0	4.5
9. Chigley	4.0	4.0	4.0	---	---	3.0	5.0
10. Chigley	3.0	3.0	3.0	---	---	---	3.5
11. Chigley and Clarita	3.0	3.0	---	---	---	---	---
12. Clarita	4.5	4.0	4.5	4.5	3.0	3.8	4.5
13. Clarita	3.5	3.0	3.0	---	2.5	3.0	3.5
14. Clarita	3.0	2.5	---	---	---	---	3.0
15. Dale	8.5	---	---	---	4.0	4.5	---
17. Durant	6.0	5.0	5.0	---	3.5	4.0	6.0
18. Durant	5.5	5.0	4.5	---	3.5	4.0	5.5
19. Durant	5.0	4.5	3.0	---	2.5	3.5	3.5
20. Durant	3.0	3.0	---	---	---	---	---
21. Elandco	8.0	---	---	---	3.8	4.5	---
22. Galey	6.0	6.0	2.0	---	3.8	4.3	7.0
23. Garvin	7.0	---	---	5.0	3.0	3.5	---
24. Garvin and Elandco	6.5	---	---	5.0	---	---	---
25. Gracemont	8.0	---	---	7.0	3.0	3.8	---
26. Grainola	4.0	4.0	3.0	---	---	---	3.5
30. Justin	7.0	7.5	7.0	---	3.0	4.0	8.5
31. Justin	6.5	7.0	6.5	---	3.0	4.0	7.5
32. Keokuk	8.0	---	---	---	4.0	4.5	---
34. Konawa	5.5	6.0	5.5	---	2.5	3.6	6.5
35. Konawa	5.0	6.0	5.5	---	3.5	4.3	6.5
36. Konawa	4.5	5.0	---	---	---	---	---

See footnote at end of table.

TABLE 5.--ANNUAL GRAZING YIELDS--Continued

Map symbol and soil name	Animal-unit-months (AUM*) per acre						
	Improved bermuda-grass	Weeping lovegrass	King Ranch bluestem	Tall fescue	Forage sorghum	Small grain grazeout	Caucasian or plains bluestem
37. Konawa------	4.0	5.0	---	---	---	---	---
38. Konawa------	7.0	8.0	7.0	---	3.8	4.3	8.5
39. Konawa------	6.0	6.0	6.0	---	3.5	4.3	7.0
40. Konawa------	5.5	5.5	5.5	---	---	---	6.5
41. Konsil------	6.0	7.5	7.0	---	3.8	4.0	8.0
42. Konsil------	5.5	7.0	6.0	---	2.0	3.0	7.0
43. Konsil------	4.0	4.5	4.5	---	---	---	5.0
44. Lela--------	5.5	---	---	5.0	3.5	3.8	---
45. Loco--------	3.0	3.0	3.0	---	---	---	3.5
47. Lucien-Nash-	4.0	5.0	4.0	---	---	---	5.0
48. McLain------	7.0	---	---	5.0	3.8	4.5	---
50. Newalla-----	6.0	6.0	6.0	---	2.0	3.5	7.0
51. Newalla-----	5.0	5.0	5.0	---	---	---	5.5
52. Newalla-----	4.5	4.5	4.5	---	---	---	5.0
53. Norge-------	7.5	7.5	7.5	---	3.8	4.0	8.0
54. Norge-------	7.0	7.0	7.0	---	3.5	4.0	8.0
56. Port--------	8.5	---	---	5.0	4.0	4.5	---
57. Port--------	8.5	---	---	5.0	4.0	4.5	---
58. Port and Pulaski----	7.0	---	---	5.0	---	---	---
59. Pulaski-----	7.5	---	---	---	---	---	---
60. Rayford-----	---	---	---	---	---	---	---
61. Renfrow-----	4.5	4.5	4.5	---	2.8	3.5	5.5
62. Renfrow-----	4.0	4.0	4.0	---	2.5	3.0	4.5
63. Renfrow-----	3.0	3.0	3.0	---	2.0	3.0	3.5
64. Renfrow-----	2.0	2.0	---	---	---	---	---
66. Stephenville	6.0	6.0	5.5	---	2.0	3.0	6.5
67. Stephenville	5.5	5.5	5.0	---	---	2.8	6.0
68. Stephenville	5.0	5.0	---	---	---	---	---
69. Stephenville	4.0	4.0	---	---	---	---	---
70. Stephenville and Newalla	3.5	3.5	---	---	---	---	---
71. Teller------	5.5	5.5	5.0	---	3.0	4.0	6.0
72. Teller------	5.0	5.5	---	---	---	---	---

See footnote at end of table.

TABLE 5.--ANNUAL GRAZING YIELDS--Continued

Map symbol and soil name	Animal-unit-months (AUM*) per acre						
	Improved bermuda-grass	Weeping lovegrass	King Ranch bluestem	Tall fescue	Forage sorghum	Small grain grazeout	Caucasian or plains bluestem
73. Teller------	4.0	4.0	---	---	---	---	---
74. Teller------	6.5	6.5	5.5	---	3.8	4.5	7.0
75. Teller------	6.0	6.5	5.5	---	3.5	4.0	7.0
76. Teller------	5.5	6.0	5.0	---	3.0	3.5	6.0
79. Tussy-------	4.0	4.0	3.0	---	---	---	3.5
80. Tussy-------	3.5	3.5	---	---	---	---	---
81. Urban land--	---	---	---	---	---	---	---
82. Vanoss------	7.0	7.0	---	---	---	---	---
83. Wilson------	5.0	4.5	3.5	4.5	---	2.4	4.0
84. Yahola------	7.5	---	---	---	3.5	4.0	---
85. Yahola-Gaddy	7.0	---	---	---	---	---	---
86. Zaneis------	6.5	6.5	4.0	---	2.5	3.8	6.5
87. Zaneis------	6.0	6.0	3.5	---	2.0	3.5	4.5
88. Zaneis------	5.0	5.0	---	---	---	---	---
89. Zaneis------	4.0	4.0	---	---	---	---	---

*AUM (animal-unit-month) is the amount of forage or feed required to feed one animal unit (one cow, one horse, five sheep, or five goats) for 30 days.

TABLE 6.--YIELDS PER ACRE OF CROPS

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Map symbol and soil name	Wheat	Cotton lint	Soybeans	Grain sorghum	Alfalfa hay	Peanuts
	Bu	Lb	Bu	Bu	Tons	Lb
1-------------------------- Amber	35	450	30	60	4.5	1,500
2-------------------------- Asa	40	500	35	60	5.0	1,500
3-------------------------- Asher	40	450	35	60	4.5	1,600
5-------------------------- Bergstrom	40	500	35	60	5.0	1,600
6-------------------------- Bethany	35	400	30	55	3.0	1,400
7-------------------------- Bethany	30	350	25	50	2.5	1,200
8-------------------------- Burleson	30	350	25	50	---	---
9-------------------------- Chigley	20	250	15	40	---	---
12------------------------- Clarita	25	275	20	45	---	---
13------------------------- Clarita	20	225	15	40	---	---
15------------------------- Dale	40	500	35	65	5.0	1,700
17------------------------- Durant	35	400	30	55	3.0	1,400
18------------------------- Durant	30	350	25	50	2.5	1,200
19------------------------- Durant	25	300	20	45	---	---
21------------------------- Elandco	40	500	35	60	5.0	1,500
22------------------------- Galey	25	350	20	40	3.0	1,300
23------------------------- Garvin	35	450	30	60	4.5	---
25------------------------- Gracemont	25	350	20	35	3.5	---
26------------------------- Grainola	15	150	10	20	---	---
30------------------------- Justin	35	450	30	60	3.5	1,500

TABLE 6.--YIELDS PER ACRE OF CROPS--Continued

Map symbol and soil name	Wheat	Cotton lint	Soybeans	Grain sorghum	Alfalfa hay	Peanuts
	Bu	Lb	Bu	Bu	Tons	Lb
31----------------------- Justin	30	400	25	55	3.0	1,400
32----------------------- Keokuk	40	500	35	65	5.0	1,700
34----------------------- Konawa	20	250	15	30	2.0	1,900
35----------------------- Konawa	15	200	10	25	1.5	700
38----------------------- Konawa	30	400	25	55	3.0	1,400
39----------------------- Konawa	20	300	15	40	2.0	1,000
40----------------------- Konawa	20	300	15	40	2.0	1,000
41----------------------- Konsil	25	350	20	40	3.0	1,300
42----------------------- Konsil	20	250	15	30	2.0	900
44----------------------- Lela	30	400	25	55	4.0	---
48----------------------- McLain	35	450	30	60	4.5	1,600
50----------------------- Newalla	25	300	20	40	2.0	1,000
51----------------------- Newalla	20	250	15	35	1.5	800
52----------------------- Newalla	15	200	10	30	1.0	600
53----------------------- Norge	35	450	30	60	3.5	1,500
54----------------------- Norge	30	400	25	55	3.0	1,400
56----------------------- Port	40	500	35	60	5.0	1,600
57----------------------- Port	40	500	35	60	5.0	1,500
59----------------------- Pulaski	30	425	25	50	3.5	1,600
61----------------------- Renfrow	25	250	20	30	---	---
62----------------------- Renfrow	20	200	15	25	---	---

TABLE 6.--YIELDS PER ACRE OF CROPS--Continued

Map symbol and soil name	Wheat	Cotton lint	Soybeans	Grain sorghum	Alfalfa hay	Peanuts
	Bu	Lb	Bu	Bu	Tons	Lb
63------------------------- Renfrow	15	150	10	20	---	---
66------------------------- Stephenville	30	400	25	50	2.5	1,400
67------------------------- Stephenville	25	350	20	45	2.0	1,200
68------------------------- Stephenville	20	300	15	40	1.5	1,000
71------------------------- Teller	20	300	15	40	2.0	1,000
72------------------------- Teller	15	250	10	30	1.0	800
74------------------------- Teller	35	450	30	60	3.5	1,500
75------------------------- Teller	30	400	25	55	3.0	1,400
76------------------------- Teller	25	350	20	50	2.5	1,200
79------------------------- Tussy	15	150	10	20	---	---
81. Urban land						
82------------------------- Vanoss	30	350	25	55	3.0	1,400
83------------------------- Wilson	25	350	20	50	---	---
84------------------------- Yahola	30	425	25	50	3.5	1,600
86------------------------- Zaneis	30	400	25	55	2.5	1,400
87------------------------- Zaneis	25	350	20	50	2.0	1,200
88------------------------- Zaneis	20	250	15	40	---	1,000

TABLE 7.--RANGELAND PRODUCTIVITY

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Map symbol and soil name	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
1----------------------- Amber	Loamy Bottomland----------------------	8,500	6,100	4,500
2----------------------- Asa	Loamy Bottomland----------------------	8,000	6,100	4,500
3----------------------- Asher	Loamy Bottomland----------------------	8,000	5,600	4,000
5----------------------- Bergstrom	Loamy Bottomland----------------------	8,500	6,100	4,500
6, 7-------------------- Bethany	Loamy Prairie-------------------------	5,000	3,500	2,500
8----------------------- Burleson	Blackclay Prairie---------------------	6,500	4,700	3,500
9, 10------------------- Chigley	Sandy Savannah------------------------	5,000	3,500	2,500
11*:				
Chigley-----------------	Eroded Sandy Savannah-----------------	2,500	1,750	1,250
Clarita-----------------	Eroded Prairie------------------------	3,300	2,400	1,800
12---------------------- Clarita	Blackclay Prairie---------------------	6,500	4,700	3,500
13, 14------------------ Clarita	Blackclay Prairie---------------------	5,700	4,100	3,100
15---------------------- Dale	Loamy Bottomland----------------------	8,500	6,100	4,500
17, 18------------------ Durant	Loamy Prairie-------------------------	6,000	4,200	3,000
19---------------------- Durant	Loamy Prairie-------------------------	5,200	3,600	2,600
20---------------------- Durant	Eroded Prairie------------------------	3,000	2,100	1,500
21---------------------- Elandco	Loamy Bottomland----------------------	8,500	6,100	4,500
22---------------------- Galey	Deep Sand Savannah--------------------	4,000	3,100	2,500
23---------------------- Garvin	Heavy Bottomland----------------------	6,000	3,900	2,500
24*:				
Garvin------------------	Heavy Bottomland----------------------	6,000	3,900	2,500
Elandco-----------------	Loamy Bottomland----------------------	8,500	6,100	4,500
25---------------------- Gracemont	Subirrigated--------------------------	9,000	7,800	7,000
26, 27------------------ Grainola	Shallow Prairie-----------------------	4,000	2,800	2,000

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY--Continued

Map symbol and soil name	Range site	Potential annual production for kind of growing season		
		Favorable Lb/acre	Average Lb/acre	Unfavorable Lb/acre
28 Grainola	Shallow Prairie	3,500	2,400	1,700
30, 31 Justin	Loamy Prairie	5,500	4,000	3,000
32 Keokuk	Loamy Bottomland	8,500	6,100	4,500
34 Konawa	Deep Sand Savannah	3,800	2,700	1,800
35 Konawa	Deep Sand Savannah	3,300	2,100	1,500
36 Konawa	Eroded Sandy Savannah	2,500	1,600	1,250
37 Konawa	Deep Sand Savannah	3,800	2,700	1,800
38 Konawa	Sandy Savannah	4,500	3,800	2,500
39 Konawa	Sandy Savannah	4,000	2,900	2,200
40 Konawa	Sandy Savannah	4,500	3,800	2,500
41, 42 Konsil	Deep Sand Savannah	4,000	3,100	2,500
43 Konsil	Eroded Sandy Savannah	2,500	1,600	1,250
44 Lela	Heavy Bottomland	5,500	3,700	2,500
45 Loco	Shallow Prairie	2,500	1,800	1,300
46 Lucien	Shallow Prairie	3,000	2,100	1,500
47*:				
Lucien	Shallow Prairie	3,000	2,100	1,500
Nash	Loamy Prairie	4,800	3,300	2,300
48 McLain	Heavy Bottomland	6,000	4,200	3,000
50, 51 Newalla	Sandy Savannah	4,500	3,300	2,500
52 Newalla	Sandy Savannah	4,000	2,900	2,200
53, 54 Norge	Loamy Prairie	5,500	3,000	2,000
56, 57 Port	Loamy Bottomland	8,500	6,100	4,500
58*:				
Port	Loamy Bottomland	8,500	6,100	4,500
Pulaski	Loamy Bottomland	7,000	4,900	3,500

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY--Continued

Map symbol and soil name	Range site	Potential annual production for kind of growing season		
		Favorable Lb/acre	Average Lb/acre	Unfavorable Lb/acre
59----------------------- Pulaski	Loamy Bottomland-----------------------	7,000	4,900	3,500
60----------------------- Rayford	Shallow Prairie------------------------	2,200	1,200	500
61, 62------------------- Renfrow	Claypan Prairie------------------------	4,000	2,800	2,000
63----------------------- Renfrow	Claypan Prairie------------------------	3,500	2,500	1,800
64----------------------- Renfrow	Eroded Clay----------------------------	2,000	1,400	1,000
66, 67------------------- Stephenville	Sandy Savannah-------------------------	4,500	3,300	2,500
68----------------------- Stephenville	Sandy Savannah-------------------------	4,000	2,900	2,200
69*:				
Stephenville------------	Sandy Savannah-------------------------	4,500	3,300	2,500
Darnell-----------------	Shallow Savannah-----------------------	3,200	2,100	1,400
70*:				
Stephenville------------	Eroded Sandy Savannah------------------	2,300	1,700	1,300
Newalla-----------------	Eroded Sandy Savannah------------------	2,300	1,700	1,300
71, 72------------------- Teller	Loamy Prairie--------------------------	4,800	3,600	2,600
73----------------------- Teller	Eroded Prairie-------------------------	2,800	2,000	1,500
74, 75, 76--------------- Teller	Loamy Prairie--------------------------	5,500	4,000	3,000
79----------------------- Tussy	Red Clay Prairie-----------------------	2,500	1,600	1,000
80----------------------- Tussy	Red Clay Prairie-----------------------	2,200	1,400	900
82----------------------- Vanoss	Loamy Prairie--------------------------	5,500	4,000	3,000
83----------------------- Wilson	Claypan Prairie------------------------	5,000	3,500	2,500
84----------------------- Yahola	Loamy Bottomland-----------------------	7,000	4,900	3,500
85*:				
Yahola------------------	Loamy Bottomland-----------------------	7,000	4,900	3,500
Gaddy-------------------	Sandy Bottomland-----------------------	3,800	2,700	2,000
86, 87------------------- Zaneis	Loamy Prairie--------------------------	5,500	4,000	3,000
88----------------------- Zaneis	Loamy Prairie--------------------------	4,800	3,600	2,600
89----------------------- Zaneis	Eroded Prairie-------------------------	2,800	2,000	1,500

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1. Amber	Skunkbush sumac	American plum, lilac.	Austrian pine, redbud, eastern redcedar.	Osageorange	Eastern cottonwood, Chinese elm, American sycamore, black locust, honeylocust.
2. Asa	Skunkbush sumac	American plum, lilac.	Austrian pine, redbud, eastern redcedar.	Osageorange	Eastern cottonwood, American sycamore, Chinese elm, black locust, honeylocust.
3. Asher	Skunkbush sumac	American plum, lilac.	Austrian pine, redbud, eastern redcedar.	Osageorange	Eastern cottonwood, Chinese elm, honeylocust, American sycamore, black locust.
4*:					
Asher	Skunkbush sumac	American plum, lilac.	Austrian pine, redbud, eastern redcedar.	Osageorange	Eastern cottonwood, Chinese elm, honeylocust, American sycamore, black locust.
Urban land.					
5. Bergstrom	Skunkbush sumac	American plum, lilac.	Austrian pine, redbud, eastern redcedar.	Osageorange	Eastern cottonwood, Chinese elm, honeylocust, American sycamore, black locust.
6, 7. Bethany	Skunkbush sumac, lilac.	Amur honeysuckle, redbud, Austrian pine, ponderosa pine.	Eastern redcedar, bur oak, Chinese elm, osageorange, honeylocust, silver maple.	---	---
8. Burleson	Skunkbush sumac, lilac.	Austrian pine, redbud, Amur honeysuckle.	Eastern redcedar, Chinese elm, honeylocust, silver maple, osageorange, bur oak, red mulberry.	---	---
9, 10. Chigley	Lilac, skunkbush sumac.	Austrian pine, ponderosa pine, Amur honeysuckle, redbud.	Hackberry, osageorange, Chinese elm, honeylocust, eastern redcedar, silver maple.	---	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
11*:					
Chigley	Lilac, skunkbush sumac.	Austrian pine, ponderosa pine, Amur honeysuckle, redbud.	Hackberry, osageorange, Chinese elm, honeylocust, eastern redcedar, silver maple.	---	---
Clarita	Skunkbush sumac, lilac.	Amur honeysuckle, redbud, ponderosa pine, Austrian pine.	Eastern redcedar, hackberry, honeylocust, osageorange, Chinese elm, silver maple.	---	---
12, 13, 14 Clarita	Skunkbush sumac, lilac.	Amur honeysuckle, redbud, ponderosa pine, Austrian pine.	Eastern redcedar, hackberry, honeylocust, osageorange, Chinese elm, silver maple.	---	---
15 Dale	Skunkbush sumac	Amur honeysuckle, American plum, lilac.	Eastern redcedar, Austrian pine, redbud.	Osageorange	American sycamore, honeylocust, eastern cottonwood, Chinese elm.
16*:					
Dale	Skunkbush sumac	Amur honeysuckle, American plum, lilac.	Eastern redcedar, Austrian pine, redbud.	Osageorange	American sycamore, honeylocust, eastern cottonwood, Chinese elm.
Urban land.					
17, 18, 19, 20 Durant	Skunkbush sumac, lilac.	Ponderosa pine, Amur honeysuckle, Austrian pine, redbud.	Honeylocust, silver maple, osageorange, Chinese elm, eastern redcedar, hackberry.	---	---
21 Elandco	Skunkbush sumac	American plum, Amur honeysuckle, lilac.	Austrian pine, eastern redcedar.	Green ash, osageorange, red mulberry.	Chinese elm, eastern cottonwood, American sycamore.
22 Galey	Skunkbush sumac	American plum, lilac, Amur honeysuckle.	Eastern redcedar, Austrian pine, redbud.	Honeylocust, Chinese elm, silver maple, osageorange, hackberry.	---
23 Garvin	Skunkbush sumac	Amur honeysuckle, lilac.	Austrian pine, American plum, redbud, eastern redcedar.	Osageorange, silver maple, honeylocust.	Eastern cottonwood, American sycamore.
24*:					
Garvin	Skunkbush sumac	Amur honeysuckle, lilac.	Austrian pine, American plum, redbud, eastern redcedar.	Osageorange, silver maple, honeylocust.	Eastern cottonwood, American sycamore.
Elandco	Skunkbush sumac	Amur honeysuckle, American plum, lilac.	Austrian pine, eastern redcedar.	Green ash, red mulberry, osageorange.	Chinese elm, eastern cottonwood, American sycamore.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
25. Gracemont	Skunkbush sumac	American plum, Amur honeysuckle, lilac.	Redbud	Osageorange, green ash, hackberry, honeylocust, silver maple.	Eastern cottonwood, American sycamore.
26, 27. Grainola	Amur honeysuckle, Siberian peashrub.	Eastern redcedar, Rocky Mountain juniper, hackberry.	Honeylocust, Russian-olive.	---	---
28. Grainola	Lilac, skunkbush sumac.	Amur honeysuckle, redbud.	Eastern redcedar, honeylocust, hackberry, osageorange, Chinese elm, red mulberry, silver maple, Russian-olive.	---	---
29*:					
Grainola	Skunkbush sumac, lilac.	Eastern redcedar, Austrian pine, Rocky Mountain juniper, hackberry, Amur honeysuckle, redbud.	Honeylocust, hackberry, Russian-olive, osageorange.	---	---
Urban land.					
30, 31. Justin	Skunkbush sumac	Amur honeysuckle, lilac, American plum.	Austrian pine, eastern redcedar, redbud.	Osageorange, hackberry, Chinese elm, silver maple, honeylocust.	---
32. Keokuk	Skunkbush sumac	American plum, lilac.	Austrian pine, eastern redcedar, redbud.	Osageorange	Honeylocust, black locust, eastern cottonwood, American sycamore, Chinese elm.
33*:					
Keokuk	Skunkbush sumac	American plum, lilac.	Austrian pine, eastern redcedar, redbud.	Osageorange	Honeylocust, black locust, eastern cottonwood, American sycamore, Chinese elm.
Urban land.					
34, 35, 36, 37, 38, 39, 40. Konawa	Skunkbush sumac	American plum, lilac, Amur honeysuckle.	Ponderosa pine, Austrian pine, eastern redcedar, Scotch pine.	Chinese elm, red mulberry, honeylocust, black locust.	---
41, 42, 43. Konsil	Skunkbush sumac	American plum, Amur honeysuckle, lilac.	Ponderosa pine, Scotch pine, eastern redcedar, Austrian pine.	Chinese elm, black locust, red mulberry, honeylocust.	---
44. Lela	Skunkbush sumac	Amur honeysuckle, lilac.	Austrian pine, green ash, bur oak, eastern redcedar.	Osageorange, honeylocust, red mulberry.	Eastern cottonwood, American sycamore.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
45----------------- Loco	Lilac, Amur honeysuckle, skunkbush sumac.	Rocky Mountain juniper, redbud.	Eastern redcedar, osageorange, Arizona cypress, oriental arborvitae.	---	---
46----------------- Lucien	Amur honeysuckle, skunkbush sumac, lilac.	Rocky Mountain juniper, redbud.	Osageorange, eastern redcedar, Arizona cypress, oriental arborvitae.	---	---
47*: Lucien------------	Amur honeysuckle, skunkbush sumac, lilac.	Rocky Mountain juniper, redbud.	Osageorange, eastern redcedar, Arizona cypress, oriental arborvitae.	---	---
Nash--------------	Skunkbush sumac---	American plum, lilac, Amur honeysuckle.	Austrian pine, redbud, eastern redcedar.	Osageorange, Chinese elm, black locust, hackberry, bur oak.	---
48----------------- McLain	Skunkbush sumac---	Lilac, Amur honeysuckle.	Eastern redcedar, Austrian pine, redbud, green ash.	Osageorange, Chinese elm, honeylocust.	American sycamore, eastern cottonwood.
49*: McLain------------	Skunkbush sumac---	Lilac, Amur honeysuckle.	Eastern redcedar, Austrian pine, redbud, green ash.	Osageorange, Chinese elm, honeylocust.	American sycamore, eastern cottonwood.
Urban land.					
50, 51, 52--------- Newalla	Skunkbush sumac, lilac.	Austrian pine, redbud, Amur honeysuckle.	Honeylocust, eastern redcedar, osageorange, silver maple, Chinese elm, red mulberry, hackberry.	---	---
53, 54------------ Norge	Skunkbush sumac---	American plum, Amur honeysuckle, lilac.	Eastern redcedar, Austrian pine, redbud.	Osageorange, black locust, hackberry, Chinese elm, honeylocust.	---
55*. Oil-wasteland					
56, 57------------ Port	Skunkbush sumac---	Amur honeysuckle, American plum, lilac.	Austrian pine, eastern redcedar.	Green ash, red mulberry, osageorange.	American sycamore, eastern cottonwood, Chinese elm.
58*: Port--------------	Skunkbush sumac---	Amur honeysuckle, American plum, lilac.	Austrian pine, eastern redcedar.	Green ash, red mulberry, osageorange.	American sycamore, eastern cottonwood, Chinese elm.
Pulaski-----------	Skunkbush sumac---	American plum, lilac, Amur honeysuckle.	Austrian pine, eastern redcedar, redbud.	Osageorange, green ash.	Eastern cottonwood, honeylocust, American sycamore.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
59. Pulaski	Skunkbush sumac	American plum, lilac, Amur honeysuckle.	Austrian pine, eastern redcedar, redbud.	Osageorange, green ash.	Eastern cottonwood, honeylocust, American sycamore.
60. Rayford	Amur honeysuckle, skunkbush sumac, lilac.	Rocky Mountain juniper, redbud.	Osageorange, eastern redcedar, Arizona cypress, oriental arborvitae.	---	---
61, 62, 63, 64. Renfrow	Lilac, skunkbush sumac.	Austrian pine, redbud, Amur honeysuckle.	Eastern redcedar, silver maple, hackberry, osageorange, Chinese elm, honeylocust, Russian-olive.	---	---
65*:					
Renfrow	Lilac, skunkbush sumac.	Austrian pine, redbud, Amur honeysuckle.	Eastern redcedar, silver maple, hackberry, osageorange, Chinese elm, honeylocust, Russian-olive.	---	---
Urban land.					
66, 67, 68. Stephenville	Skunkbush sumac	American plum, Amur honeysuckle, lilac.	Eastern redcedar, Austrian pine, redbud.	Osageorange, red mulberry, green ash, Chinese elm, bur oak.	---
69*:					
Stephenville	Skunkbush sumac	American plum, Amur honeysuckle, lilac.	Austrian pine, redbud.	Osageorange, red mulberry, green ash, Chinese elm, bur oak.	---
Darnell	Amur honeysuckle, lilac, skunkbush sumac.	Oriental arborvitae, Rocky Mountain juniper, redbud.	Eastern redcedar, osageorange, Arizona cypress.	---	---
70*:					
Stephenville	Skunkbush sumac	American plum, Amur honeysuckle, lilac.	Eastern redcedar, Austrian pine, redbud.	Osageorange, red mulberry, green ash, Chinese elm, bur oak.	---
Newalla	Skunkbush sumac, lilac.	Austrian pine, redbud, Amur honeysuckle.	Honeylocust, eastern redcedar, osageorange, silver maple, Chinese elm, red mulberry, hackberry.	---	---
71, 72, 73, 74, 75, 76. Teller	Skunkbush sumac	Amur honeysuckle, American plum, lilac.	Redbud, eastern redcedar, Austrian pine.	Osageorange, hackberry, honeylocust, silver maple.	Chinese elm.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
78*: Teller	Skunkbush sumac	Amur honeysuckle, American plum, lilac.	Redbud, eastern redcedar, Austrian pine.	Osageorange, hackberry, honeylocust, silver maple.	Chinese elm.
Urban land.					
79 Tussy	Lilac, skunkbush sumac.	Austrian pine, Amur honeysuckle, redbud.	Eastern redcedar, honeylocust, hackberry, osageorange, Chinese elm, red mulberry.	---	---
80 Tussy	Lilac, skunkbush sumac.	Eastern redcedar	---	---	---
81*. Urban land					
82 Vanoss	Skunkbush sumac	American plum, Amur honeysuckle, lilac.	Austrian pine, redbud, eastern redcedar.	Osageorange, honeylocust, Chinese elm, black locust, hackberry.	---
83 Wilson	Skunkbush sumac, lilac.	Redbud, Austrian pine, Amur honeysuckle.	Chinese elm, Russian-olive, osageorange, silver maple, hackberry, honeylocust, eastern redcedar.	---	---
84 Yahola	Skunkbush sumac	American plum, lilac.	Austrian pine, eastern redcedar, ponderosa pine, Scotch pine.	Red mulberry, osageorange.	Eastern cottonwood, Chinese elm, American sycamore.
85*: Yahola	Skunkbush sumac	American plum, lilac.	Austrian pine, eastern redcedar, ponderosa pine, Scotch pine.	Red mulberry, osageorange.	Eastern cottonwood, Chinese elm, American sycamore.
Gaddy	Skunkbush sumac	American plum, Amur honeysuckle, lilac.	Eastern redcedar, autumn-olive, Austrian pine.	Chinese elm, red mulberry, osageorange.	Eastern cottonwood, American sycamore.
86, 87, 88, 89 Zaneis	Skunkbush sumac	Amur honeysuckle, lilac, American plum.	Eastern redcedar, Austrian pine, redbud.	Honeylocust, red mulberry, osageorange, Chinese elm, hackberry.	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1 Amber	Severe: flooding.	Slight	Moderate: slope.	Severe: erodes easily.	Slight.
2 Asa	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
3 Asher	Severe: flooding.	Slight	Slight	Slight	Slight.
4*:					
Asher	Severe: flooding.	Slight	Slight	Slight	Slight.
Urban land.					
5 Bergstrom	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
6 Bethany	Slight	Slight	Slight	Severe: erodes easily.	Slight.
7 Bethany	Slight	Slight	Moderate: slope.	Severe: erodes easily.	Slight.
8 Burleson	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Severe: too clayey.	Moderate: too clayey.	Severe: too clayey.
9 Chigley	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight	Moderate: small stones.
10 Chigley	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight	Moderate: small stones, slope.
11*:					
Chigley	Moderate: small stones.	Moderate: small stones.	Severe: slope, small stones.	Slight	Moderate: small stones.
Clarita	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Severe: slope.	Severe: erodes easily.	Severe: too clayey.
12, 13 Clarita	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey.	Severe: erodes easily.	Severe: too clayey.
14 Clarita	Moderate: percs slowly, slope, too clayey.	Moderate: percs slowly, slope, too clayey.	Severe: slope.	Severe: erodes easily.	Severe: too clayey.
15 Dale	Severe: flooding.	Slight	Slight	Slight	Slight.
16*:					
Dale	Severe: flooding.	Slight	Slight	Slight	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
16*: Urban land.					
17 Durant	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: percs slowly.	Severe: erodes easily.	Slight.
18, 19, 20 Durant	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Severe: erodes easily.	Slight.
21 Elandco	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
22 Galey	Slight	Slight	Moderate: slope.	Slight	Slight.
23 Garvin	Severe: flooding.	Moderate: percs slowly.	Moderate: flooding, percs slowly.	Slight	Moderate: flooding.
24*: Garvin	Severe: flooding.	Moderate: flooding, too clayey, percs slowly.	Severe: flooding, too clayey.	Moderate: flooding, too clayey.	Severe: too clayey, flooding.
Elandco	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Slight	Severe: flooding.
25 Gracemont	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
26 Grainola	Slight	Slight	Moderate: small stones, slope, depth to rock.	Severe: erodes easily.	Moderate: thin layer.
27 Grainola	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
28 Grainola	Severe: large stones, small stones, slope.	Severe: large stones, small stones, slope.	Severe: large stones, small stones, slope.	Moderate: large stones, slope.	Severe: small stones, large stones, slope.
29*: Grainola	Slight	Slight	Severe: slope.	Severe: erodes easily.	Moderate: thin layer.
Urban land.					
30 Justin	Slight	Slight	Slight	Severe: erodes easily.	Slight.
31 Justin	Slight	Slight	Moderate: slope.	Severe: erodes easily.	Slight.
32 Keokuk	Severe: flooding.	Slight	Slight	Slight	Slight.
33*: Keokuk	Severe: flooding.	Slight	Slight	Slight	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
33*: Urban land.					
34, 35, 36 Konawa	Slight	Slight	Severe: slope.	Slight	Moderate: droughty.
37 Konawa	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
38, 39 Konawa	Slight	Slight	Moderate: slope.	Slight	Slight.
40 Konawa	Slight	Slight	Severe: slope.	Slight	Slight.
41 Konsil	Slight	Slight	Moderate: slope.	Slight	Slight.
42, 43 Konsil	Slight	Slight	Severe: slope.	Slight	Slight.
44 Lela	Severe: flooding.	Moderate: percs slowly, too clayey.	Severe: too clayey.	Moderate: too clayey.	Severe: too clayey.
45 Loco	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.	Severe: thin layer.
46 Lucien	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: thin layer, slope.
47*: Lucien	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight	Severe: thin layer.
Nash	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope, thin layer.
48 McLain	Severe: flooding.	Slight	Slight	Slight	Slight.
49*: McLain	Severe: flooding.	Slight	Slight	Slight	Slight.
Urban land.					
50, 51, 52 Newalla	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Severe: erodes easily.	Slight.
53 Norge	Slight	Slight	Slight	Severe: erodes easily.	Slight.
54 Norge	Slight	Slight	Moderate: slope.	Severe: erodes easily.	Slight.
55*. Oil-wasteland					

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
56, 57: Port	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
58*:					
Port	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
Pulaski	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
59: Pulaski	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
60: Rayford	Severe: large stones, slope, depth to rock.	Severe: large stones, slope, depth to rock.	Severe: large stones, slope, depth to rock.	Moderate: large stones, slope.	Severe: large stones, slope, thin layer.
61, 62, 63, 64: Renfrow	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Severe: erodes easily.	Slight.
65*:					
Renfrow	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Severe: erodes easily.	Slight.
Urban land.					
66, 67, 68: Stephenville	Slight	Slight	Moderate: slope, depth to rock.	Slight	Moderate: thin layer.
69*:					
Stephenville	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Moderate: slope, large stones.	Severe: slope.
Darnell	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight	Severe: thin layer.
70*:					
Stephenville	Slight	Slight	Severe: slope.	Slight	Moderate: thin layer.
Newalla	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Severe: erodes easily.	Slight.
71: Teller	Slight	Slight	Moderate: slope.	Slight	Slight.
72, 73: Teller	Slight	Slight	Severe: slope.	Slight	Slight.
74: Teller	Slight	Slight	Slight	Severe: erodes easily.	Slight.
75, 76: Teller	Slight	Slight	Moderate: slope.	Severe: erodes easily.	Slight.
78*:					
Teller	Slight	Slight	Moderate: slope.	Severe: erodes easily.	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
78*: Urban land.					
79 Tussy	Moderate: small stones, percs slowly.	Moderate: small stones, percs slowly.	Severe: small stones, too clayey.	Severe: erodes easily.	Severe: too clayey.
80 Tussy	Severe: slope.	Severe: slope.	Severe: small stones, too clayey, slope.	Severe: erodes easily.	Severe: too clayey, slope.
81*. Urban land					
82 Vanoss	Slight	Slight	Moderate: slope.	Severe: erodes easily.	Slight.
83 Wilson	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, erodes easily.	Severe: wetness.
84 Yahola	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
85*:					
Yahola	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
Gaddy	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
86, 87, 88, 89 Zaneis	Slight	Slight	Moderate: slope.	Severe: erodes easily.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
1---Amber	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
2---Asa	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
3---Asher	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Good.
4*:									
Asher---	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Good.
Urban land.									
5---Bergstrom	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
6, 7---Bethany	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
8---Burleson	Good	Good	Poor	Poor	Very poor	Very poor	Fair	Very poor	Poor.
9---Chigley	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
10---Chigley	Fair	Good	Good	Fair	Very poor	Very poor	Good	Very poor	Fair.
11*:									
Chigley---	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Clarita---	Fair	Fair	Poor	Poor	Poor	Very poor	Fair	Very poor	Poor.
12, 13, 14---Clarita	Fair	Fair	Poor	Poor	Poor	Very poor	Fair	Very poor	Poor.
15---Dale	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.
16*:									
Dale---	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.
Urban land.									
17, 18---Durant	Good	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
19, 20---Durant	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
21---Elandco	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.
22---Galey	Fair	Fair	Good	Good	Poor	Very poor	Fair	Very poor	Good.
23---Garvin	Good	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
24*:									
Garvin---	Poor	Fair	Poor	Poor	Poor	Poor	Poor	Poor	Poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
24*:									
Elandco	Very poor	Poor	Fair	Good	Poor	Very poor	Poor	Very poor	Fair.
25 Gracemont	Fair	Good	Good	Good	Fair	Poor	Good	Poor	Good.
26 Grainola	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
27 Grainola	Poor	Fair	Fair	Poor	Very poor	Very poor	Fair	Very poor	Poor.
28 Grainola	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
29*:									
Grainola	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Urban land.									
30, 31 Justin	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
32 Keokuk	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
33*:									
Keokuk	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
Urban land.									
34, 35, 36 Konawa	Fair	Fair	Good	Good	Poor	Very poor	Fair	Very poor	Good.
37 Konawa	Poor	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
38, 39 Konawa	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
40 Konawa	Fair	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
41, 42, 43 Konsil	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
44 Lela	Fair	Fair	Poor	Fair	Poor	Fair	Fair	Poor	Poor.
45 Loco	Poor	Poor	Fair	Fair	Poor	Very poor	Poor	Very poor	Fair.
46 Lucien	Poor	Poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
47*:									
Lucien	Poor	Poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Nash	Fair	Good	Good	Fair	Very poor	Very poor	Good	Very poor	Fair.
48 McLain	Good	Good	Fair	Good	Poor	Poor	Good	Poor	Fair.
49*:									
McLain	Good	Good	Fair	Good	Poor	Poor	Good	Poor	Fair.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
49*:									
Urban land.									
50, 51, 52--------- Newalla	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
53, 54------------- Norge	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
55*. Oil-wasteland									
56, 57------------- Port	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
58*:									
Port---------------	Poor	Fair	Fair	Good	Poor	Very poor	Fair	Very poor	Fair.
Pulaski------------	Poor	Fair	Fair	Good	Poor	Very poor	Fair	Very poor	Fair.
59----------------- Pulaski	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
60----------------- Rayford	Very poor	Poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
61, 62, 63, 64----- Renfrow	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
65*:									
Renfrow------------	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Urban land.									
66, 67, 68--------- Stephenville	Fair	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
69*:									
Stephenville-------	Poor	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
Darnell------------	Poor	Poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
70*:									
Stephenville-------	Fair	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
Newalla------------	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
71, 72------------- Teller	Fair	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
73----------------- Teller	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
74, 75, 76--------- Teller	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
78*:									
Teller-------------	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
Urban land.									
79----------------- Tussy	Fair	Fair	Poor	Poor	Very poor	Very poor	Fair	Very poor	Poor.
80----------------- Tussy	Very poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
81*. Urban land									
82----------------- Vanoss	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
83----------------- Wilson	Fair	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair.
84----------------- Yahola	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
85*:									
Yahola-------------	Poor	Fair	Fair	Good	Poor	Very poor	Fair	Very poor	Fair.
Gaddy--------------	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
86, 87, 88--------- Zaneis	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
89----------------- Zaneis	Poor	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1 Amber	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.
2 Asa	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
3 Asher	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.
4*:						
Asher	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.
Urban land.						
5 Bergstrom	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
6, 7 Bethany	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Slight.
8 Burleson	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
9 Chigley	Moderate: too clayey, wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell.	Moderate: small stones.
10 Chigley	Moderate: too clayey, wetness, slope.	Moderate: shrink-swell, slope.	Moderate: wetness, slope, shrink-swell.	Severe: slope.	Moderate: slope, shrink-swell.	Moderate: small stones, slope.
11*:						
Chigley	Moderate: too clayey, wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell.	Moderate: small stones.
Clarita	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: too clayey.
12, 13 Clarita	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: too clayey.
14 Clarita	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: slope, shrink-swell.	Severe: shrink-swell.	Severe: too clayey.
15 Dale	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: shrink-swell, flooding.	Slight.
16*:						
Dale	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: shrink-swell, flooding.	Slight.
Urban land.						
17, 18, 19, 20 Durant	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Slight.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
21 Elandco	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
22 Galey	Moderate: wetness.	Slight	Moderate: wetness.	Slight	Slight	Slight.
23 Garvin	Moderate: too clayey, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Moderate: flooding.
24*:						
Garvin	Moderate: too clayey, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: too clayey, flooding.
Elandco	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: flooding.
25 Gracemont	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: wetness.
26 Grainola	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Moderate: thin layer.
27 Grainola	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: slope.
28 Grainola	Severe: slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: small stones, large stones, slope.
29*:						
Grainola	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Moderate: thin layer.
Urban land.						
30, 31 Justin	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
32 Keokuk	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.
33*:						
Keokuk	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.
Urban land.						
34, 35, 36 Konawa	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
37 Konawa	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Slight	Severe: slope.
38 Konawa	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Slight.
39, 40 Konawa	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Slight.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
41----------------- Konsil	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: low strength.	Slight.
42, 43------------ Konsil	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: low strength.	Slight.
44----------------- Lela	Severe: cutbanks cave.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell.	Severe: too clayey.
45----------------- Loco	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Moderate: depth to rock, shrink-swell.	Severe: thin layer.
46----------------- Lucien	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: thin layer, slope.
47*:						
Lucien-----------	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope.	Severe: thin layer.
Nash-------------	Moderate: depth to rock, slope.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope.	Moderate: slope, thin layer.
48----------------- McLain	Moderate: too clayey.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell.	Slight.
49*:						
McLain-----------	Moderate: too clayey.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell.	Slight.
Urban land.						
50, 51, 52-------- Newalla	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Slight.
53, 54------------ Norge	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Slight.
55*. Oil-wasteland						
56, 57------------ Port	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
58*:						
Port-------------	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Pulaski----------	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
59----------------- Pulaski	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
60----------------- Rayford	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: large stones, slope, thin layer.
61, 62, 63, 64---- Renfrow	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Slight.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
65*:						
Renfrow	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Slight.
Urban land.						
66 Stephenville	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Slight	Slight	Moderate: thin layer.
67, 68 Stephenville	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Moderate: slope.	Slight	Moderate: thin layer.
69*:						
Stephenville	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Darnell	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope.	Severe: thin layer.
70*:						
Stephenville	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Moderate: slope.	Slight	Moderate: thin layer.
Newalla	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Slight.
71, 72, 73 Teller	Slight	Slight	Slight	Moderate: slope.	Slight	Slight.
74, 75 Teller	Slight	Slight	Slight	Slight	Slight	Slight.
76 Teller	Slight	Slight	Slight	Moderate: slope.	Slight	Slight.
78*:						
Teller	Slight	Slight	Slight	Moderate: slope.	Slight	Slight.
Urban land.						
79 Tussy	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: too clayey.
80 Tussy	Severe: slope.	Severe: slope, shrink-swell.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: too clayey, slope.
81*. Urban land						
82 Vanoss	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Slight.
83 Wilson	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
84 Yahola	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
85*:						
Yahola	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Gaddy	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
86----------------- Zaneis	Slight----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Slight.
87, 88, 89--------- Zaneis	Slight----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1 Amber	Moderate: flooding, percs slowly.	Moderate: seepage, slope.	Moderate: flooding.	Moderate: flooding.	Good.
2 Asa	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
3 Asher	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
4*:					
Asher	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
Urban land.					
5 Bergstrom	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
6 Bethany	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
7 Bethany	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
8 Burleson	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
9 Chigley	Severe: wetness, percs slowly.	Severe: wetness.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
10 Chigley	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
11*:					
Chigley	Severe: wetness, percs slowly.	Severe: wetness.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
Clarita	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
12, 13 Clarita	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
14 Clarita	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
15 Dale	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
16*:					
Dale	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
Urban land.					
17 Durant	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
18, 19, 20 Durant	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
21 Elandco	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
22 Galey	Moderate: wetness, percs slowly.	Moderate: seepage, slope, wetness.	Slight	Slight	Good.
23 Garvin	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
24*:					
Garvin	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
Elandco	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
25 Gracemont	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: wetness.
26 Grainola	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
27 Grainola	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
28 Grainola	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey, slope.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
29*:					
Grainola	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Urban land.					
30 Justin	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
31 Justin	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
32 Keokuk	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
33*:					
Keokuk	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
Urban land.					
34, 35, 36 Konawa	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Slight	Good.
37 Konawa	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: slope.	Poor: slope.
38, 39, 40 Konawa	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Slight	Good.
41, 42, 43 Konsil	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
44 Lela	Severe: percs slowly.	Slight	Severe: too clayey.	Moderate: flooding.	Poor: too clayey, hard to pack.
45 Loco	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
46 Lucien	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, slope.
47*:					
Lucien	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim.
Nash	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
48 McLain	Severe: percs slowly.	Slight	Moderate: flooding, too clayey.	Moderate: flooding.	Poor: hard to pack.
49*:					
McLain	Severe: percs slowly.	Slight	Moderate: flooding, too clayey.	Moderate: flooding.	Poor: hard to pack.
Urban land.					
50, 51, 52 Newalla	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
53 Norge	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
54 Norge	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
55*. Oil-wasteland					
56, 57 Port	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
58*:					
Port	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
Pulaski	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Good.
59 Pulaski	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Good.
60 Rayford	Severe: depth to rock, slope.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: area reclaim, slope, large stones.
61, 62, 63, 64 Renfrow	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
65*:					
Renfrow	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
Urban land.					
66, 67, 68 Stephenville	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
69*:					
Stephenville	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
Darnell	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim.
70*:					
Stephenville	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Newalla	Severe: percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
71, 72, 73, 76	Moderate: percs slowly.	Severe: seepage, slope.	Severe: seepage.	Slight	Fair: too clayey.
74, 75 Teller	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Slight	Fair: too clayey.
78*:					
Teller	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Slight	Fair: too clayey.
Urban land.					

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
79----------------- Tussy	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack, small stones.
80----------------- Tussy	Severe: percs slowly, slope.	Severe: slope.	Severe: too clayey, slope.	Severe: slope.	Poor: too clayey, hard to pack, slope.
81*. Urban land					
82----------------- Vanoss	Moderate: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
83----------------- Wilson	Severe: wetness, percs slowly.	Slight-----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
84----------------- Yahola	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Good.
85*:					
Yahola-------------	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Good.
Gaddy--------------	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, too sandy.	Severe: flooding, seepage.	Poor: too sandy, seepage.
86, 87, 88, 89------ Zaneis	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock.	Moderate: depth to rock.	Fair: area reclaim, too clayey.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1-----Amber	Good-----	Improbable: excess fines.	Improbable: excess fines.	Good.
2-----Asa	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
3-----Asher	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
4*:				
Asher-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Urban land.				
5-----Bergstrom	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
6, 7-----Bethany	Poor: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
8-----Burleson	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
9, 10-----Chigley	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, too clayey.
11*:				
Chigley-----	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, too clayey.
Clarita-----	Poor: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
12, 13, 14-----Clarita	Poor: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
15-----Dale	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
16*:				
Dale-----	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
Urban land.				
17, 18, 19, 20-----Durant	Poor: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
21-----Elandco	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
22-----Galey	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
23-----Garvin	Poor: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
24*:				
Garvin	Poor: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Elandco	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
25 Gracemont	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
26 Grainola	Poor: area reclaim, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
27 Grainola	Poor: area reclaim, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope, too clayey.
28 Grainola	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope, too clayey.
29*:				
Grainola	Poor: area reclaim, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Urban land.				
30, 31 Justin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
32 Keokuk	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
33*:				
Keokuk	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Urban land.				
34, 35, 36 Konawa	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
37 Konawa	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
38, 39, 40 Konawa	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
41, 42, 43 Konsil	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
44 Lela	Poor: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
45 Loco	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
46 Lucien	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones, slope.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
47*:				
Lucien	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
Nash	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer, slope.
48 McLain	Poor: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
49*:				
McLain	Poor: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Urban land.				
50, 51, 52 Newalla	Poor: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
53, 54 Norge	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
55*. Oil-wasteland				
56, 57 Port	Moderate: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
58*:				
Port	Moderate: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
Pulaski	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
59 Pulaski	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
60 Rayford	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope, large stones.
61, 62, 63, 64 Renfrow	Poor: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
65*:				
Renfrow	Poor: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Urban land.				
66, 67, 68 Stephenville	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
69*:				
Stephenville	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope, large stones.
Darnell	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
70*:				
Stephenville	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
Newalla	Poor: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
71, 72, 73, 74, 75, 76 Teller	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
78*:				
Teller	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Urban land.				
79 Tussy	Poor: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
80 Tussy	Poor: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope, too clayey.
81*. Urban land				
82 Vanoss	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
83 Wilson	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
84 Yahola	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
85*:				
Yahola	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Gaddy	Good	Probable	Improbable: too sandy.	Poor: too sandy.
86, 87, 88, 89 Zaneis	Fair: area reclaim, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Irrigation	Terraces and diversions	Grassed waterways
1 Amber	Moderate: seepage.	Severe: piping.	Severe: no water.	Erodes easily	Erodes easily	Erodes easily.
2 Asa	Moderate: seepage.	Severe: piping.	Severe: no water.	Flooding, erodes easily.	Erodes easily	Erodes easily.
3 Asher	Moderate: seepage.	Severe: piping.	Severe: no water.	Percs slowly	Percs slowly	Percs slowly.
4*:						
Asher	Moderate: seepage.	Severe: piping.	Severe: no water.	Percs slowly	Percs slowly	Percs slowly.
Urban land.						
5 Bergstrom	Moderate: seepage.	Moderate: piping.	Severe: no water.	Erodes easily, flooding.	Erodes easily	Erodes easily.
6, 7 Bethany	Slight	Moderate: hard to pack.	Severe: no water.	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
8 Burleson	Slight	Severe: hard to pack.	Severe: no water.	Slow intake, percs slowly.	Percs slowly	Percs slowly.
9 Chigley	Moderate: slope.	Moderate: piping, hard to pack.	Severe: no water.	Slope	Favorable	Favorable.
10 Chigley	Severe: slope.	Moderate: piping, hard to pack.	Severe: no water.	Slope	Slope	Slope.
11*:						
Chigley	Moderate: slope.	Moderate: piping, hard to pack.	Severe: no water.	Slope	Favorable	Favorable.
Clarita	Moderate: slope.	Severe: hard to pack.	Severe: no water.	Slow intake, percs slowly, slope.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
12, 13 Clarita	Moderate: slope.	Severe: hard to pack.	Severe: no water.	Slow intake, percs slowly, slope.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
14 Clarita	Severe: slope.	Severe: hard to pack.	Severe: no water.	Slow intake, percs slowly, slope.	Erodes easily, percs slowly, slope.	Erodes easily, percs slowly, slope.
15 Dale	Moderate: seepage.	Moderate: piping.	Severe: no water.	Erodes easily	Erodes easily	Erodes easily.
16*:						
Dale	Moderate: seepage.	Moderate: piping.	Severe: no water.	Erodes easily	Erodes easily	Erodes easily.
Urban land.						
17, 18 Durant	Slight	Moderate: hard to pack.	Severe: no water.	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
19, 20 Durant	Moderate: slope.	Moderate: hard to pack.	Severe: no water.	Percs slowly, slope, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Irrigation	Terraces and diversions	Grassed waterways
21----------------- Elandco	Moderate: seepage.	Moderate: piping.	Severe: no water.	Erodes easily, flooding.	Erodes easily	Erodes easily.
22----------------- Galey	Moderate: seepage.	Moderate: piping.	Severe: no water.	Fast intake, soil blowing.	Soil blowing---	Favorable.
23----------------- Garvin	Slight----------	Moderate: hard to pack.	Severe: no water.	Percs slowly, flooding.	Percs slowly---	Percs slowly.
24*:						
Garvin-----------	Slight----------	Moderate: hard to pack.	Severe: no water.	Slow intake, percs slowly.	Percs slowly---	Percs slowly.
Elandco----------	Moderate: seepage.	Severe: piping.	Severe: no water.	Erodes easily, flooding.	Erodes easily	Erodes easily.
25----------------- Gracemont	Severe: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Wetness, soil blowing, flooding.	Wetness, soil blowing.	Wetness.
26----------------- Grainola	Moderate: depth to rock, slope.	Moderate: thin layer, hard to pack.	Severe: no water.	Percs slowly, depth to rock, slope.	Percs slowly, depth to rock, erodes easily.	Percs slowly, erodes easily, depth to rock.
27----------------- Grainola	Severe: slope.	Moderate: thin layer, hard to pack.	Severe: no water.	Percs slowly, depth to rock, slope.	Slope, depth to rock, erodes easily.	Depth to rock, slope, erodes easily.
28----------------- Grainola	Severe: slope.	Moderate: thin layer, hard to pack.	Severe: no water.	Percs slowly, depth to rock, slope.	Depth to rock, slope, percs slowly.	Depth to rock, slope, percs slowly.
29*:						
Grainola---------	Moderate: depth to rock, slope.	Moderate: thin layer, hard to pack.	Severe: no water.	Percs slowly, depth to rock, slope.	Percs slowly, depth to rock, erodes easily.	Percs slowly, erodes easily, depth to rock.
Urban land.						
30, 31------------ Justin	Slight----------	Slight----------	Severe: no water.	Favorable------	Favorable------	Favorable.
32----------------- Keokuk	Moderate: seepage.	Severe: piping.	Severe: no water.	Favorable------	Favorable------	Favorable.
33*:						
Keokuk-----------	Moderate: seepage.	Severe: piping.	Severe: no water.	Favorable------	Favorable------	Favorable.
Urban land.						
34, 35, 36-------- Konawa	Severe: seepage.	Moderate: piping.	Severe: no water.	Droughty, fast intake, slope.	Soil blowing---	Droughty.
37----------------- Konawa	Severe: seepage, slope.	Moderate: piping.	Severe: no water.	Droughty, fast intake, slope.	Soil blowing, slope.	Droughty, slope.
38----------------- Konawa	Severe: seepage.	Moderate: piping.	Severe: no water.	Favorable------	Favorable------	Favorable.
39, 40------------ Konawa	Severe: seepage.	Moderate: piping.	Severe: no water.	Slope----------	Favorable------	Favorable.
41----------------- Konsil	Moderate: seepage.	Moderate: piping.	Severe: no water.	Fast intake, soil blowing.	Soil blowing---	Favorable.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Irrigation	Terraces and diversions	Grassed waterways
42, 43 Konsil	Moderate: seepage.	Moderate: piping.	Severe: no water.	Fast intake, soil blowing, slope.	Soil blowing	Favorable.
44 Lela	Slight	Moderate: hard to pack.	Severe: no water.	Slow intake, percs slowly.	Percs slowly	Percs slowly.
45 Loco	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Depth to rock, slope, erodes easily.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
46 Lucien	Severe: seepage, depth to rock, slope.	Severe: thin layer, piping.	Severe: no water.	Large stones, depth to rock, slope.	Large stones, depth to rock, slope.	Large stones, depth to rock, slope.
47*: Lucien	Severe: depth to rock, seepage, slope.	Severe: piping, thin layer.	Severe: no water.	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
Nash	Severe: slope.	Severe: piping.	Severe: no water.	Depth to rock, slope, erodes easily.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
48 McLain	Slight	Severe: hard to pack.	Severe: no water.	Percs slowly	Percs slowly	Percs slowly.
49*: McLain	Slight	Severe: hard to pack.	Severe: no water.	Percs slowly	Percs slowly	Percs slowly.
Urban land.						
50 Newalla	Moderate: depth to rock.	Moderate: thin layer, hard to pack.	Severe: no water.	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
51, 52 Newalla	Moderate: depth to rock, slope.	Moderate: thin layer, hard to pack.	Severe: no water.	Percs slowly, slope, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
53, 54 Norge	Slight	Moderate: piping.	Severe: no water.	Erodes easily	Erodes easily	Erodes easily.
55*. Oil-wasteland						
56, 57 Port	Moderate: seepage.	Moderate: piping.	Severe: no water.	Flooding	Favorable	Favorable.
58*: Port	Moderate: seepage.	Moderate: piping.	Severe: no water.	Flooding	Favorable	Favorable.
Pulaski	Severe: seepage.	Severe: piping.	Severe: no water.	Flooding	Favorable	Favorable.
59 Pulaski	Severe: seepage.	Severe: piping.	Severe: no water.	Flooding	Favorable	Favorable.
60 Rayford	Severe: depth to rock, slope.	Severe: thin layer, large stones.	Severe: no water.	Large stones, depth to rock, slope.	Large stones, slope, depth to rock.	Large stones, slope, depth to rock.
61 Renfrow	Slight	Severe: hard to pack.	Severe: no water.	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Irrigation	Terraces and diversions	Grassed waterways
62, 63, 64-------- Renfrow	Slight----------	Severe: hard to pack.	Severe: no water.	Percs slowly, slope, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
65*:						
Renfrow----------	Slight----------	Severe: hard to pack.	Severe: no water.	Percs slowly, slope, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Urban land.						
66---------------- Stephenville	Moderate: seepage, depth to rock.	Severe: thin layer.	Severe: no water.	Depth to rock	Depth to rock	Depth to rock.
67, 68------------ Stephenville	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Severe: no water.	Depth to rock, slope.	Depth to rock	Depth to rock.
69*:						
Stephenville-----	Severe: slope.	Severe: thin layer.	Severe: no water.	Depth to rock, slope, large stones.	Depth to rock, slope, large stones.	Depth to rock, slope, large stones.
Darnell----------	Severe: depth to rock, slope, seepage.	Severe: piping.	Severe: no water.	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
70*:						
Stephenville-----	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Severe: no water.	Depth to rock, slope.	Depth to rock	Depth to rock.
Newalla----------	Moderate: depth to rock, slope.	Moderate: thin layer, hard to pack.	Severe: no water.	Percs slowly, slope, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
71, 72, 73-------- Teller	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Slope-----------	Favorable------	Favorable.
74, 75------------ Teller	Moderate: seepage.	Severe: piping.	Severe: no water.	Erodes easily	Erodes easily	Erodes easily.
76---------------- Teller	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Slope, erodes easily.	Erodes easily	Erodes easily.
78*:						
Teller-----------	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Slope, erodes easily.	Erodes easily	Erodes easily.
Urban land.						
79---------------- Tussy	Moderate: slope.	Moderate: hard to pack.	Severe: no water.	Slow intake, percs slowly, slope.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
80---------------- Tussy	Severe: slope.	Moderate: hard to pack.	Severe: no water.	Slow intake, percs slowly, slope.	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
81*. Urban land						
82---------------- Vanoss	Moderate: seepage.	Slight----------	Severe: no water.	Erodes easily	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Irrigation	Terraces and diversions	Grassed waterways
83----------------- Wilson	Slight----------	Severe: hard to pack, wetness.	Severe: no water.	Wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
84----------------- Yahola	Severe: seepage.	Severe: piping.	Severe: no water.	Soil blowing, flooding.	Soil blowing---	Favorable.
85*:						
Yahola------------	Severe: seepage.	Severe: piping.	Severe: no water.	Soil blowing, flooding.	Soil blowing---	Favorable.
Gaddy-------------	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
86----------------- Zaneis	Moderate: depth to rock.	Severe: piping.	Severe: no water.	Erodes easily	Erodes easily	Erodes easily.
87, 88, 89--------- Zaneis	Moderate: depth to rock, slope.	Severe: piping.	Severe: no water.	Slope, erodes easily.	Erodes easily	Erodes easily.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated. Some soils may have Unified classifications and USDA textures in addition to those shown. In general, the dominant classifications and textures are shown]

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
1----------------- Amber	0-9	Very fine sandy loam.	CL, ML, CL-ML	A-4	0	100	100	94-100	51-97	<30	NP-9
	9-42	Very fine sandy loam, loam, silt loam.	CL, ML, CL-ML	A-4	0	100	100	94-100	51-97	<30	NP-9
	42-80	Stratified silt loam to loamy fine sand.	SC, SM, SM-SC	A-2, A-4	0	100	98-100	90-100	25-40	<30	NP-9
2----------------- Asa	0-11	Silty clay loam	CL	A-6, A-7	0	98-100	98-100	95-100	85-100	32-42	15-25
	11-45	Silty clay loam, silt loam.	CL, CL-ML	A-6, A-4	0	98-100	98-100	90-100	70-100	25-40	6-20
	45-72	Very fine sandy loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	98-100	98-100	85-100	60-100	20-55	6-20
3----------------- Asher	0-16	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-98	33-50	12-25
	16-38	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-98	33-50	12-25
	38-80	Stratified silt loam to loamy fine sand.	ML, CL, CL-ML	A-4	0	100	98-100	90-100	75-90	<30	NP-10
4*: Asher------------	0-16	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-98	33-50	12-25
	16-38	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-98	33-50	12-25
	38-80	Stratified silt loam to loamy fine sand.	ML, CL, CL-ML	A-4	0	100	98-100	90-100	75-90	<30	NP-10
Urban land.											
5----------------- Bergstrom	0-22	Silt loam---------	CL	A-4, A-6, A-7	0	95-100	95-100	95-100	85-97	28-46	8-25
	22-71	Silty clay loam, silt loam, clay loam.	CL	A-6, A-7	0	95-100	95-100	95-100	85-97	32-46	12-25
	71-80	Stratified loam to clay.	CL	A-6, A-7	0	95-100	95-100	95-100	85-97	30-45	11-25
6----------------- Bethany	0-7	Silt loam---------	CL, ML, CL-ML	A-4, A-6	0	100	100	96-100	80-98	21-40	1-15
	7-16	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	96-100	80-98	33-50	15-26
	16-78	Silty clay, clay, silty clay loam.	CL, CH	A-7, A-6	0	100	96-100	96-100	90-99	37-60	15-33
7----------------- Bethany	0-1	Silt loam---------	CL, ML, CL-ML	A-4, A-6	0	100	100	96-100	80-98	21-40	1-15
	1-20	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	96-100	80-98	33-50	15-26
	20-81	Silty clay, clay, silty clay loam.	CL, CH	A-7, A-6	0	100	96-100	96-100	90-99	37-60	15-33
8----------------- Burleson	0-20	Clay---------------	CH	A-7	0-2	83-100	80-100	80-100	80-96	51-90	27-55
	20-66	Clay, silty clay	CH	A-7	0-1	95-100	80-100	75-99	70-95	51-90	30-55

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	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	
9----------------- Chigley	0-6	Gravelly sandy loam.	SM, SM-SC	A-2, A-4	0	55-75	55-75	50-75	20-45	<25	NP-4
	6-42	Sandy clay, clay, gravelly clay loam.	CL, CH, SC	A-2, A-6, A-7	0	50-90	50-90	50-90	20-85	35-60	14-35
	42-54	Sandy clay, clay, gravelly sandy clay loam.	CL, CH, SC	A-2, A-6, A-7	0	50-90	50-90	50-90	15-85	25-60	11-35
	54-64	Gravelly sandy clay, gravelly clay, very gravelly clay loam.	SC, GC, CL, CH	A-2, A-6, A-7	0	35-70	35-70	35-70	13-65	25-60	11-35
10---------------- Chigley	0-7	Gravelly sandy loam.	SM, SM-SC	A-2, A-4	0	55-75	55-75	50-75	20-45	<25	NP-4
	7-46	Sandy clay, clay, gravelly clay loam.	CL, CH, SC	A-2, A-6, A-7	0	50-90	50-90	50-90	20-85	35-60	14-35
	46-60	Sandy clay, clay, gravelly sandy clay loam.	CL, CH, SC	A-2, A-6, A-7	0	50-90	50-90	50-90	15-85	25-60	11-35
11*: Chigley----------	0-6	Gravelly loam----	ML, CL-ML, SM, SM-SC	A-4	0	55-75	55-75	50-75	36-65	22-29	2-7
	6-45	Sandy clay, clay, gravelly clay loam.	CL, CH, SC	A-2, A-6, A-7	0	50-90	50-90	50-90	20-85	35-60	14-35
	45-57	Sandy clay, clay, gravelly sandy clay loam.	CL, CH, SC	A-2, A-6, A-7	0	50-90	50-90	50-90	15-85	25-60	11-35
	57-62	Gravelly sandy clay, gravelly clay, very gravelly clay loam.	SC, GC, CL, CH	A-2, A-6, A-7	0	35-70	35-70	35-70	13-65	25-60	11-35
Clarita----------	0-6	Clay--------------	CL, CH	A-7	0	95-100	95-100	95-100	90-99	41-60	20-35
	6-50	Clay, silty clay, silty clay loam.	CL, CH	A-6, A-7	0	95-100	95-100	95-100	80-99	37-60	15-35
	50-60	Clay--------------	CL, CH	A-7	0	85-100	85-100	85-100	80-95	45-60	20-35
12---------------- Clarita	0-25	Clay--------------	CL, CH	A-7	0	95-100	95-100	95-100	90-99	41-60	20-35
	25-45	Clay, silty clay, silty clay loam.	CL, CH	A-6, A-7	0	95-100	95-100	95-100	80-99	37-60	15-35
	45-80	Clay--------------	CL, CH	A-7	0	85-100	85-100	85-100	80-95	45-60	20-35
13---------------- Clarita	0-8	Clay--------------	CL, CH	A-7	0	95-100	95-100	95-100	90-99	41-60	20-35
	8-40	Clay, silty clay, silty clay loam.	CL, CH	A-6, A-7	0	95-100	95-100	95-100	80-99	37-60	15-35
	40-60	Clay--------------	CL, CH	A-7	0	85-100	85-100	85-100	80-95	45-60	20-35
14---------------- Clarita	0-4	Clay--------------	CL, CH	A-7	0	95-100	95-100	95-100	90-99	41-60	20-35
	4-40	Clay, silty clay, silty clay loam.	CL, CH	A-6, A-7	0	95-100	95-100	95-100	80-99	37-60	15-35
	40-60	Clay--------------	CL, CH	A-7	0	85-100	85-100	85-100	80-95	45-60	20-35
15---------------- Dale	0-22	Silt loam---------	CL, CL-ML	A-4, A-6	0	95-100	95-100	90-100	65-98	25-35	5-15
	22-72	Silt loam, loam, silty clay loam.	CL	A-4, A-6, A-7	0	95-100	95-100	90-100	65-98	30-43	8-20
16*: Dale-------------	0-22	Silt loam---------	CL, CL-ML	A-4, A-6	0	95-100	95-100	90-100	65-98	25-35	5-15
	22-72	Silt loam, loam, silty clay loam.	CL	A-4, A-6, A-7	0	95-100	95-100	90-100	65-98	30-43	8-20
Urban land.											

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
17---------------- Durant	0-12	Loam--------------	CL	A-4, A-6	0	100	100	96-100	65-97	30-37	8-14
	12-18	Clay loam, silty clay loam, clay.	CL, CH	A-6, A-7	0	100	100	96-100	80-98	37-70	15-39
	18-70	Clay--------------	CL, CH, MH	A-7	0	100	100	96-100	80-95	45-70	21-39
18---------------- Durant	0-10	Loam--------------	CL	A-4, A-6	0	100	100	96-100	65-97	30-37	8-14
	10-14	Clay loam, silty clay loam, clay.	CL, CH	A-6, A-7	0	100	100	96-100	80-98	37-70	15-39
	14-60	Clay--------------	CL, CH, MH	A-7	0	100	100	96-100	80-95	45-70	21-39
19---------------- Durant	0-6	Loam--------------	CL	A-4, A-6	0	100	100	96-100	65-97	30-37	8-14
	6-60	Clay--------------	CL, CH, MH	A-7	0	100	100	96-100	80-95	45-70	21-39
20---------------- Durant	0-3	Clay loam---------	CL	A-6, A-7	0	100	100	96-100	80-90	37-49	16-26
	3-8	Clay loam, silty clay loam, clay.	CL, CH	A-6, A-7	0	100	100	96-100	80-98	37-70	15-39
	8-72	Clay--------------	CL, CH, MH	A-7	0	100	100	96-100	80-95	45-70	21-39
21---------------- Elandco	0-15	Silty clay loam	CL	A-4, A-6, A-7-6	0	100	100	95-100	85-95	25-45	8-25
	15-60	Silty clay loam, clay loam, silt loam.	CL, ML, CL-ML	A-4, A-6, A-7-6	0	100	100	95-100	65-95	20-45	4-25
22---------------- Galey	0-12	Loamy fine sand	SM	A-2	0	100	98-100	90-100	15-35	---	NP
	12-60	Sandy clay loam, fine sandy loam, clay loam.	SM-SC, SC, CL-ML, CL	A-4, A-6	0	100	98-100	90-100	40-85	26-40	6-18
23---------------- Garvin	0-9	Silty clay loam	CL	A-6, A-7	0	95-100	95-100	95-100	80-98	37-50	15-26
	9-74	Clay, silty clay, clay loam.	CL, CH	A-6, A-7	0	95-100	95-100	95-100	80-99	37-60	15-34
24*:											
Garvin-----------	0-10	Silty clay--------	CL, CH	A-7	0	100	100	96-100	90-99	41-60	18-34
	10-72	Clay, silty clay, clay loam.	CL, CH	A-6, A-7	0	95-100	95-100	95-100	80-99	37-60	15-34
Elandco----------	0-15	Silt loam---------	CL, ML, CL-ML	A-4, A-6	0	100	100	95-100	85-95	20-40	4-20
	15-60	Silty clay loam, clay loam, silt loam.	CL, ML, CL-ML	A-4, A-6, A-7-6	0	100	100	95-100	65-95	20-45	4-25
25---------------- Gracemont	0-7	Fine sandy loam	ML, CL-ML, SM, SM-SC	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	7-47	Fine sandy loam, loam.	ML, CL-ML, SM, SM-SC	A-4	0	100	98-100	94-100	36-90	22-29	2-7
	47-70	Loam, clay loam, fine sandy loam.	ML, CL, SM, SC	A-4, A-6	0	100	98-100	94-100	36-90	22-40	2-18
26---------------- Grainola	0-7	Clay loam---------	CL	A-6, A-7	0-25	75-95	75-95	60-95	60-95	37-50	14-25
	7-25	Silty clay, clay loam, clay.	CL, CH	A-7	0-15	75-90	75-90	70-90	60-90	41-70	20-40
	25-38	Clay loam, clay, very shaly silty clay.	CL, CH, SC, GC	A-2, A-7	0	20-90	20-90	20-90	15-90	41-70	20-40
	38-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
27---------------- Grainola	0-5	Clay loam---------	CL	A-6, A-7	0-25	75-95	75-95	60-95	60-95	37-50	14-25
	5-25	Silty clay, clay loam, clay.	CL, CH	A-7	0-15	75-90	75-90	70-90	60-90	41-70	20-40
	25-35	Clay loam, clay, very shaly silty clay.	CL, CH, SC, GC	A-2, A-7	0	20-90	20-90	20-90	15-90	41-70	20-40
	35-60	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol 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	
28---------------- Grainola	0-6	Cobbly clay loam	CL, SC, GC	A-2, A-6, A-7	25-55	40-95	40-95	40-95	30-95	37-50	14-25
	6-26	Clay loam, clay, silty clay.	CL, CH	A-7	0-15	75-90	75-90	70-90	60-90	41-70	20-40
	26-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
29*: Grainola---------	0-7	Clay loam---------	CL	A-6, A-7	0-25	75-95	75-95	60-95	60-95	37-50	14-25
	7-25	Silty clay, clay loam, clay.	CL, CH	A-7	0-15	75-90	75-90	70-90	60-90	41-70	20-40
	25-38	Clay loam, clay, very shaly silty clay.	CL, CH, SC, GC	A-2, A-7	0	20-90	20-90	20-90	15-90	41-70	20-40
	38-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Urban land.											
30---------------- Justin	0-14	Loam--------------	SC, CL, SM-SC, CL-ML	A-4, A-6	0	95-100	95-100	90-100	43-68	22-34	6-18
	14-72	Sandy clay loam, loam, clay loam.	SC, CL	A-6	0	95-100	95-100	90-100	48-75	30-40	15-25
31---------------- Justin	0-12	Loam--------------	SC, CL, SM-SC, CL-ML	A-4, A-6	0	95-100	95-100	90-100	43-68	22-34	6-18
	12-72	Sandy clay loam, loam, clay loam.	SC, CL	A-6	0	95-100	95-100	90-100	48-75	30-40	15-25
32---------------- Keokuk	0-16	Silt loam---------	ML, CL, CL-ML	A-4	0	100	100	94-100	51-97	<30	NP-10
	16-48	Silt loam, loam, very fine sandy loam.	ML, CL, CL-ML	A-4	0	100	100	94-100	51-97	<30	NP-10
	48-80	Stratified silt loam to loamy very fine sand.	ML, CL, SC, SM	A-2, A-4	0	100	98-100	90-100	36-97	<30	NP-10
33*: Keokuk-----------	0-16	Silt loam---------	ML, CL, CL-ML	A-4	0	100	100	94-100	51-97	<30	NP-10
	16-48	Silt loam, loam, very fine sandy loam.	ML, CL, CL-ML	A-4	0	100	100	94-100	51-97	<30	NP-10
	48-80	Stratified silt loam to loamy very fine sand.	ML, CL, SC, SM	A-2, A-4	0	100	98-100	90-100	36-97	<30	NP-10
Urban land.											
34---------------- Konawa	0-16	Loamy fine sand	SM	A-2	0	98-100	98-100	85-100	15-35	---	NP
	16-45	Sandy clay loam, fine sandy loam.	SC, CL	A-4, A-6	0	98-100	98-100	85-100	40-60	26-40	8-18
	45-72	Fine sandy loam, sandy clay loam, loamy fine sand.	SM, SC, CL, ML	A-4, A-6, A-2	0	98-100	98-100	85-100	15-60	<34	NP-14
35---------------- Konawa	0-5	Loamy fine sand	SM	A-2	0	98-100	98-100	85-100	15-35	---	NP
	5-45	Sandy clay loam, fine sandy loam.	SC, CL	A-4, A-6	0	98-100	98-100	85-100	40-60	26-40	8-18
	45-60	Fine sandy loam, sandy clay loam, loamy fine sand.	SM, SC, CL, ML	A-4, A-6, A-2	0	98-100	98-100	85-100	15-60	<34	NP-14
36---------------- Konawa	0-4	Loamy fine sand	SM	A-2	0	98-100	98-100	85-100	15-35	---	NP
	4-44	Sandy clay loam, fine sandy loam.	SC, CL	A-4, A-6	0	98-100	98-100	85-100	40-60	26-40	8-18
	44-60	Fine sandy loam, sandy clay loam, loamy fine sand.	SM, SC, CL, ML	A-4, A-6, A-2	0	98-100	98-100	85-100	15-60	<34	NP-14

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	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	
37----------------- Konawa	0-12	Loamy fine sand	SM	A-2	0	98-100	98-100	85-100	15-35	---	NP
	12-54	Sandy clay loam, fine sandy loam.	SC, CL	A-4, A-6	0	98-100	98-100	85-100	40-60	26-40	8-18
	54-72	Fine sandy loam, sandy clay loam, loamy fine sand.	SM, SC, CL, ML	A-4, A-6, A-2	0	98-100	98-100	85-100	15-60	<34	NP-14
38----------------- Konawa	0-12	Fine sandy loam	CL-ML, ML, SM, SM-SC	A-4	0	98-100	98-100	90-100	40-60	<26	NP-7
	12-34	Sandy clay loam, fine sandy loam.	SC, CL	A-4, A-6	0	98-100	98-100	85-100	40-60	26-40	8-18
	34-72	Fine sandy loam, sandy clay loam, loamy fine sand.	SM, SC, CL, ML	A-4, A-6, A-2	0	98-100	98-100	85-100	15-60	<34	NP-14
39----------------- Konawa	0-3	Fine sandy loam	CL-ML, ML, SM, SM-SC	A-4	0	98-100	98-100	90-100	40-60	<26	NP-7
	3-32	Sandy clay loam, fine sandy loam.	SC, CL	A-4, A-6	0	98-100	98-100	85-100	40-60	26-40	8-18
	32-70	Fine sandy loam, sandy clay loam, loamy fine sand.	SM, SC, CL, ML	A-4, A-6, A-2	0	98-100	98-100	85-100	15-60	<34	NP-14
40----------------- Konawa	0-7	Fine sandy loam	CL-ML, ML, SM, SM-SC	A-4	0	98-100	98-100	90-100	40-60	<26	NP-7
	7-50	Sandy clay loam, fine sandy loam.	SC, CL	A-4, A-6	0	98-100	98-100	85-100	40-60	26-40	8-18
	50-70	Fine sandy loam, sandy clay loam, loamy fine sand.	SM, SC, CL, ML	A-4, A-6, A-2	0	98-100	98-100	85-100	15-60	<34	NP-14
41----------------- Konsil	0-10	Loamy fine sand	SM, SM-SC	A-2, A-4	0	90-100	90-99	50-75	20-40	<25	NP-4
	10-60	Sandy clay loam, loam, fine sandy loam.	CL, SC	A-6	0	90-100	90-100	85-99	40-60	28-40	11-20
	60-64	Weathered bedrock	---	---	---	---	---	---	---	---	---
42----------------- Konsil	0-14	Loamy fine sand	SM, SM-SC	A-2, A-4	0	90-100	90-99	50-75	20-40	<25	NP-4
	14-62	Sandy clay loam, loam, fine sandy loam.	CL, SC	A-6	0	90-100	90-100	85-99	40-60	28-40	11-20
	62-70	Weathered bedrock	---	---	---	---	---	---	---	---	---
43----------------- Konsil	0-12	Loamy fine sand	SM, SM-SC	A-2, A-4	0	90-100	90-99	50-75	20-40	<25	NP-4
	12-65	Sandy clay loam, loam, fine sandy loam.	CL, SC	A-6	0	90-100	90-100	85-99	40-60	28-40	11-20
	65-80	Weathered bedrock	---	---	---	---	---	---	---	---	---
44----------------- Lela	0-24	Clay---------------	CL, CH	A-7	0	100	100	96-100	90-99	41-70	20-38
	24-72	Silty clay, clay	CL, CH	A-7	0	75-98	75-98	70-98	52-95	41-70	20-38
45----------------- Loco	0-6	Silty clay loam	CL	A-6, A-7	0	100	100	98-100	90-98	33-42	12-19
	6-17	Silt loam, silty clay loam.	CL	A-4, A-6, A-7	0	95-100	95-100	90-100	80-97	30-42	8-19
	17-26	Weathered bedrock	---	---	---	---	---	---	---	---	---
46----------------- Lucien	0-15	Stony loam--------	ML, CL, SM, SC	A-4, A-6	20-30	85-100	85-100	80-100	42-97	<35	NP-13
	15-30	Weathered bedrock	---	---	---	---	---	---	---	---	---
47*:											
Lucien-----------	0-12	Loam--------------	SM, SC, ML, CL	A-4, A-6	0-20	85-100	85-100	80-100	42-97	<35	NP-13
	12-15	Weathered bedrock	---	---	---	---	---	---	---	---	---
Nash-------------	0-28	Silt loam---------	ML, CL, CL-ML	A-4	0	100	95-100	90-100	51-97	<30	NP-10
	28-32	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	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	
48---------------- McLain	0-15	Silty clay loam	CL	A-6, A-7	0	100	100	96-100	80-99	33-43	13-19
	15-40	Silty clay loam, clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	96-100	80-99	37-60	15-34
	40-72	Silt loam, loam, silty clay loam.	CL, CH	A-4, A-6, A-7	0	100	95-100	95-100	65-99	27-60	8-34
49*:											
McLain----------	0-15	Silty clay loam	CL	A-6, A-7	0	100	100	96-100	80-99	33-43	13-19
	15-40	Silty clay loam, clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	96-100	80-99	37-60	15-34
	40-72	Silt loam, loam, silty clay loam.	CL, CH	A-4, A-6, A-7	0	100	95-100	95-100	65-99	27-60	8-34
Urban land.											
50---------------- Newalla	0-8	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	8-12	Sandy clay loam, clay loam.	CL, SC	A-4, A-6	0	100	100	90-100	36-90	25-40	8-18
	12-38	Clay, silty clay	CL, CH	A-7	0	100	100	96-100	90-99	41-60	18-34
	38-50	Sandy clay, very shaly silty clay, silty clay.	CL, CH, SC, GC	A-2, A-6, A-7	0	40-100	35-100	30-100	15-99	35-60	14-34
	50-65	Weathered bedrock	---	---	---	---	---	---	---	---	---
51---------------- Newalla	0-8	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	8-18	Sandy clay loam, clay loam.	CL, SC	A-4, A-6	0	100	100	90-100	36-90	25-40	8-18
	18-54	Clay, silty clay	CL, CH	A-7	0	100	100	96-100	90-99	41-60	18-34
	54-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
52---------------- Newalla	0-4	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	4-12	Sandy clay loam, clay loam.	CL, SC	A-4, A-6	0	100	100	90-100	36-90	25-40	8-18
	12-23	Clay, silty clay	CL, CH	A-7	0	100	100	96-100	90-99	41-60	18-34
	23-40	Sandy clay, very shaly silty clay, silty clay.	CL, CH, SC, GC	A-2, A-6, A-7	0	40-100	35-100	30-100	15-99	35-60	14-34
	40-51	Weathered bedrock	---	---	---	---	---	---	---	---	---
53---------------- Norge	0-11	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	96-100	65-97	22-37	2-14
	11-17	Silty clay loam, clay loam, silt loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	96-100	65-98	22-43	2-20
	17-45	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	96-100	80-98	33-43	12-20
	45-72	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	96-100	80-98	33-43	12-20
54---------------- Norge	0-10	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	96-100	65-97	22-37	2-14
	10-18	Silty clay loam, clay loam, silt loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	96-100	65-98	22-43	2-20
	18-45	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	96-100	80-98	33-43	12-20
	45-72	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	96-100	80-98	33-43	12-20

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	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	
55*. Oil-wasteland											
56---------------- Port	0-14	Fine sandy loam	ML, SM-SC, SM, CL-ML	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	14-72	Silty clay loam, clay loam, loam.	CL	A-4, A-6, A-7	0	100	100	96-100	65-98	27-43	8-20
57---------------- Port	0-27	Silt loam---------	CL	A-4, A-6	0	100	100	96-100	65-97	27-37	8-14
	27-72	Silty clay loam, clay loam, loam.	CL	A-4, A-6, A-7	0	100	100	96-100	65-98	27-43	8-20
58*: Port-------------	0-23	Silt loam---------	CL	A-4, A-6	0	100	100	96-100	65-97	27-37	8-14
	23-60	Silty clay loam, clay loam, loam.	CL	A-4, A-6, A-7	0	100	100	96-100	65-98	27-43	8-20
Pulaski----------	0-9	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4	0	100	95-100	90-100	36-60	<26	NP-7
	9-20	Fine sandy loam, loam.	SM, SC, ML, CL	A-4	0	100	95-100	90-100	36-85	<30	NP-10
	20-60	Fine sandy loam, loam, loamy fine sand.	SM, SC, ML, CL	A-4, A-2	0	100	95-100	90-100	15-85	<30	NP-10
59---------------- Pulaski	0-12	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4	0	100	95-100	90-100	36-60	<26	NP-7
	12-46	Fine sandy loam, loam.	SM, SC, ML, CL	A-4	0	100	95-100	90-100	36-85	<30	NP-10
	46-65	Fine sandy loam, loam, loamy fine sand.	SM, SC, ML, CL	A-4, A-2	0	100	95-100	90-100	15-85	<30	NP-10
60---------------- Rayford	0-5	Cobbly loam-------	CL	A-4, A-6	25-40	80-90	75-85	70-80	50-70	30-37	9-14
	5-12	Cobbly loam, cobbly clay loam, cobbly silty clay loam.	CL, SC	A-4, A-6, A-7	40-55	75-90	70-85	65-80	45-70	30-43	9-20
	12-14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
61---------------- Renfrow	0-8	Silt loam---------	CL	A-4, A-6	0	100	100	96-100	65-97	30-37	8-14
	8-13	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	96-100	80-98	37-49	15-26
	13-61	Clay, silty clay, silty clay loam.	CL, CH	A-6, A-7	0	100	100	96-100	80-99	37-70	15-38
	61-64	Weathered bedrock	---	---	---	---	---	---	---	---	---
62---------------- Renfrow	0-11	Silt loam---------	CL	A-4, A-6	0	100	100	96-100	65-97	30-37	8-14
	11-16	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	96-100	80-98	37-49	15-26
	16-65	Clay, silty clay, silty clay loam.	CL, CH	A-6, A-7	0	100	100	96-100	80-99	37-70	15-38
	65-72	Weathered bedrock	---	---	---	---	---	---	---	---	---
63---------------- Renfrow	0-7	Silt loam---------	CL	A-4, A-6	0	100	100	96-100	65-97	30-37	8-14
	7-63	Clay, silty clay, silty clay loam.	CL, CH	A-6, A-7	0	100	100	96-100	80-99	37-70	15-38
64---------------- Renfrow	0-5	Silt loam---------	CL	A-4, A-6	0	100	100	96-100	65-97	30-37	8-14
	5-62	Clay, silty clay, silty clay loam.	CL, CH	A-6, A-7	0	100	100	96-100	80-99	37-70	15-38
65*: Renfrow----------	0-8	Silt loam---------	CL	A-4, A-6	0	100	100	96-100	65-97	30-37	8-14
	8-13	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	96-100	80-98	37-49	15-26
	13-65	Clay, silty clay, silty clay loam.	CL, CH	A-6, A-7	0	100	100	96-100	80-99	37-70	15-38

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	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	
65*: Urban land.											
66---------------- Stephenville	0-8	Fine sandy loam	SM, SC, ML, CL	A-4	0-15	85-100	85-100	80-100	36-60	<30	NP-10
	8-34	Fine sandy loam, sandy clay loam.	SC, CL, SM-SC	A-4, A-6	0	100	98-100	90-100	36-65	20-37	7-16
	34-36	Weathered bedrock	---	---	---	---	---	---	---	---	---
67---------------- Stephenville	0-9	Fine sandy loam	SM, SC, ML, CL	A-4	0-15	85-100	85-100	80-100	36-60	<30	NP-10
	9-35	Fine sandy loam, sandy clay loam.	SC, CL, SM-SC	A-4, A-6	0	100	98-100	90-100	36-65	20-37	7-16
	35-44	Weathered bedrock	---	---	---	---	---	---	---	---	---
68---------------- Stephenville	0-6	Fine sandy loam	SM, SC, ML, CL	A-4	0-15	85-100	85-100	80-100	36-60	<30	NP-10
	6-33	Fine sandy loam, sandy clay loam.	SC, CL, SM-SC	A-4, A-6	0	100	98-100	90-100	36-65	20-37	7-16
	33-38	Weathered bedrock	---	---	---	---	---	---	---	---	---
69*: Stephenville----	0-6	Extremely stony fine sandy loam.	ML, CL, SM, SC	A-2, A-4	15-30	85-100	85-100	80-100	30-60	<30	NP-10
	6-24	Fine sandy loam, sandy clay loam.	SC, CL, SM-SC	A-4, A-6	0	100	98-100	90-100	36-65	20-37	7-16
	24-30	Weathered bedrock	---	---	---	---	---	---	---	---	---
Darnell----------	0-4	Fine sandy loam	SM, SC, ML, CL	A-4, A-2	0-15	90-100	90-100	85-100	30-60	<30	NP-10
	4-10	Fine sandy loam, loam, gravelly fine sandy loam.	SM, SC, ML, CL	A-4, A-2	0-10	70-100	70-100	60-100	25-60	<30	NP-10
	10-15	Weathered bedrock	---	---	---	---	---	---	---	---	---
70*: Stephenville----	0-5	Fine sandy loam	SM, SC, ML, CL	A-4	0-15	85-100	85-100	80-100	36-60	<30	NP-10
	5-36	Fine sandy loam, sandy clay loam.	SC, CL, SM-SC	A-4, A-6	0	100	98-100	90-100	36-65	20-37	7-16
	36-40	Weathered bedrock	---	---	---	---	---	---	---	---	---
Newalla----------	0-4	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	4-36	Clay, silty clay	CL, CH	A-7	0	100	100	96-100	90-99	41-60	18-34
	36-42	Sandy clay, very shaly silty clay, silty clay.	CL, CH, SC, GC	A-2, A-6, A-7	0	40-100	35-100	30-100	15-99	35-60	14-34
	42-50	Weathered bedrock	---	---	---	---	---	---	---	---	---
71---------------- Teller	0-5	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	5-50	Sandy clay loam, clay loam.	SC, CL	A-6, A-4	0	100	100	90-100	45-85	24-40	8-18
	50-64	Fine sandy loam, very fine sandy loam, loam.	SM, SC, ML, CL	A-4	0	100	98-100	94-100	36-85	<30	NP-10
72---------------- Teller	0-8	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	8-32	Sandy clay loam, clay loam.	SC, CL	A-6, A-4	0	100	100	90-100	45-85	24-40	8-18
	32-70	Fine sandy loam, very fine sandy loam, loam.	SM, SC, ML, CL	A-4	0	100	98-100	94-100	36-85	<30	NP-10

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	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	
73--------------- Teller	0-15	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	15-38	Sandy clay loam, clay loam.	SC, CL	A-6, A-4	0	100	100	90-100	45-85	24-40	8-18
	38-66	Fine sandy loam, very fine sandy loam, loam.	SM, SC, ML, CL	A-4	0	100	98-100	94-100	36-85	<30	NP-10
74--------------- Teller	0-18	Loam-------------	ML, CL, CL-ML	A-4	0	100	100	94-100	51-85	<30	NP-10
	18-40	Sandy clay loam, clay loam.	SC, CL	A-6, A-4	0	100	100	90-100	45-85	24-40	8-18
	40-75	Fine sandy loam, very fine sandy loam, loam.	SM, SC, ML, CL	A-4	0	100	98-100	94-100	36-85	<30	NP-10
75--------------- Teller	0-12	Loam-------------	ML, CL, CL-ML	A-4	0	100	100	94-100	51-85	<30	NP-10
	12-56	Sandy clay loam, clay loam.	SC, CL	A-6, A-4	0	100	100	90-100	45-85	24-40	8-18
	56-66	Fine sandy loam, very fine sandy loam, loam.	SM, SC, ML, CL	A-4	0	100	98-100	94-100	36-85	<30	NP-10
76--------------- Teller	0-16	Loam-------------	ML, CL, CL-ML	A-4	0	100	100	94-100	51-85	<30	NP-10
	16-52	Sandy clay loam, clay loam.	SC, CL	A-6, A-4	0	100	100	90-100	45-85	24-40	8-18
	52-70	Fine sandy loam, very fine sandy loam, loam.	SM, SC, ML, CL	A-4	0	100	98-100	94-100	36-85	<30	NP-10
78*:											
Teller----------	0-16	Loam-------------	ML, CL, CL-ML	A-4	0	100	100	94-100	51-85	<30	NP-10
	16-52	Sandy clay loam, clay loam.	SC, CL	A-6, A-4	0	100	100	90-100	45-85	24-40	8-18
	52-70	Fine sandy loam, very fine sandy loam, loam.	SM, SC, ML, CL	A-4	0	100	98-100	94-100	36-85	<30	NP-10
Urban land.											
79--------------- Tussy	0-6	Clay-------------	CL, CH	A-7	0	70-100	70-100	65-100	60-95	45-60	19-34
	6-32	Clay, silty clay	CL, CH	A-7	0-5	85-100	85-100	80-100	75-95	45-60	19-34
	32-60	Clay, shaly clay, silty clay loam.	CL, CH, GC, SC	A-7	10-25	50-85	50-85	45-85	40-85	37-60	16-34
80--------------- Tussy	0-8	Clay-------------	CL, CH	A-7	0	70-100	70-100	65-100	60-95	45-60	19-34
	8-32	Clay, silty clay	CL, CH	A-7	0-5	85-100	85-100	80-100	75-95	45-60	19-34
	32-60	Clay, shaly clay, silty clay loam.	CL, CH, GC, SC	A-7	10-25	50-85	50-85	45-85	40-85	37-60	16-34
81*. Urban land											
82--------------- Vanoss	0-12	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	100	100	96-100	65-95	22-37	2-14
	12-24	Loam, silt loam, clay loam.	CL, ML	A-4, A-6, A-7	0	100	100	96-100	65-98	30-43	8-20
	24-44	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	96-100	80-98	33-43	12-20
	44-58	Loam, silt loam, clay loam.	CL, ML	A-4, A-6, A-7	0	100	100	96-100	65-98	30-43	8-20
	58-64	Loam, silt loam, clay loam.	ML, CL, SM, SC	A-4, A-6, A-7	0	100	98-100	94-100	36-95	20-43	2-20

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	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	
83---------------- Wilson	0-8	Silt loam--------	CL	A-4, A-6	0	95-100	85-100	80-100	60-96	26-38	10-20
	8-40	Silty clay, clay, clay loam.	CL, CH	A-7-6	0	90-100	80-100	80-100	65-96	43-56	26-37
	40-60	Silty clay, clay, silty clay loam.	CL, CH	A-7-6, A-6	0	95-100	90-100	85-100	70-96	38-65	24-48
84---------------- Yahola	0-12	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4	0	100	95-100	70-100	36-60	<26	NP-7
	12-42	Fine sandy loam, loam, very fine sandy loam.	SM, ML, CL-ML, SM-SC	A-4	0	100	95-100	90-100	36-85	<26	NP-7
	42-63	Stratified clay loam to loamy fine sand.	SM, ML, CL-ML, SM-SC	A-2, A-4	0	100	95-100	90-100	15-85	<26	NP-7
85*:											
Yahola-----------	0-5	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4	0	100	95-100	70-100	36-60	<26	NP-7
	5-42	Fine sandy loam, loam, very fine sandy loam.	SM, ML, CL-ML, SM-SC	A-4	0	100	95-100	90-100	36-85	<26	NP-7
	42-70	Stratified clay loam to loamy fine sand.	SM, ML, CL-ML, SM-SC	A-2, A-4	0	100	95-100	90-100	15-85	<26	NP-7
Gaddy------------	0-10	Loamy fine sand	SM, SP-SM	A-2, A-3	0	100	98-100	80-100	5-35	---	NP
	10-60	Stratified fine sand to clay loam.	SM, SP-SM	A-2, A-3	0	100	98-100	80-100	5-35	---	NP
86---------------- Zaneis	0-12	Loam-------------	CL	A-4, A-6	0	100	98-100	91-100	65-85	30-35	9-13
	12-16	Loam, clay loam, sandy clay loam.	SC, CL	A-4, A-6	0	100	100	90-100	36-90	25-40	8-18
	16-42	Clay loam, sandy clay loam.	CL, SC	A-4, A-6	0	100	100	90-100	36-90	25-40	8-18
	42-54	Clay loam, sandy clay loam, fine sandy loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0-10	90-100	90-100	85-100	30-90	20-40	4-18
	54-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
87---------------- Zaneis	0-10	Loam-------------	CL	A-4, A-6	0	100	98-100	91-100	65-85	30-35	9-13
	10-18	Loam, clay loam, sandy clay loam.	SC, CL	A-4, A-6	0	100	100	90-100	36-90	25-40	8-18
	18-51	Clay loam, sandy clay loam.	CL, SC	A-4, A-6	0	100	100	90-100	36-90	25-40	8-18
	51-57	Clay loam, sandy clay loam, fine sandy loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0-10	90-100	90-100	85-100	30-90	20-40	4-18
	57-62	Weathered bedrock	---	---	---	---	---	---	---	---	---
88---------------- Zaneis	0-6	Loam-------------	CL	A-4, A-6	0	100	98-100	91-100	65-85	30-35	9-13
	6-11	Loam, clay loam, sandy clay loam.	SC, CL	A-4, A-6	0	100	100	90-100	36-90	25-40	8-18
	11-51	Clay loam, sandy clay loam.	CL, SC	A-4, A-6	0	100	100	90-100	36-90	25-40	8-18
	51-57	Clay loam, sandy clay loam, fine sandy loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0-10	90-100	90-100	85-100	30-90	20-40	4-18
	57-62	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	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	
89----------------	0-6	Loam--------------	CL	A-4, A-6	0	100	98-100	91-100	65-85	30-35	9-13
Zaneis	6-10	Loam, clay loam, sandy clay loam.	SC, CL	A-4, A-6	0	100	100	90-100	36-90	25-40	8-18
	10-36	Clay loam, sandy clay loam.	CL, SC	A-4, A-6	0	100	100	90-100	36-90	25-40	8-18
	36-45	Clay loam, sandy clay loam, fine sandy loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0-10	90-100	90-100	85-100	30-90	20-40	4-18
	45-62	Weathered bedrock	---	---	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
1	0-9	10-18	1.30-1.55	0.6-2.0	0.13-0.20	6.1-8.4	Low	0.37	5	---	<1
Amber	9-42	10-18	1.30-1.60	0.6-2.0	0.13-0.20	6.1-8.4	Low	0.37			
	42-80	5-18	1.30-1.60	0.6-2.0	0.10-0.20	7.9-8.4	Low	0.37			
2	0-11	27-35	1.20-1.45	0.6-2.0	0.18-0.22	6.6-8.4	Moderate	0.32	5	---	1-3
Asa	11-45	18-35	1.25-1.50	0.6-2.0	0.17-0.22	7.9-8.4	Moderate	0.43			
	45-72	10-35	1.25-1.50	0.6-2.0	0.15-0.22	7.9-8.4	Low	0.43			
3	0-16	27-40	1.30-1.60	0.06-0.2	0.18-0.22	6.1-8.4	Moderate	0.37	5	---	1-3
Asher	16-38	27-40	1.45-1.70	0.06-0.2	0.18-0.22	6.6-8.4	Moderate	0.37			
	38-80	5-18	1.40-1.65	0.6-2.0	0.10-0.20	7.9-8.4	Low	0.37			
4*:											
Asher	0-16	27-40	1.30-1.60	0.06-0.2	0.18-0.22	6.1-8.4	Moderate	0.37	5	---	1-3
	16-38	27-40	1.45-1.70	0.06-0.2	0.18-0.22	6.6-8.4	Moderate	0.37			
	38-80	5-18	1.40-1.65	0.6-2.0	0.10-0.20	7.9-8.4	Low	0.37			
Urban land.											
5	0-22	12-27	1.30-1.55	0.6-2.0	0.16-0.20	7.9-8.4	Moderate	0.37	5	---	1-3
Bergstrom	22-71	22-35	1.40-1.70	0.6-2.0	0.16-0.20	7.9-8.4	Moderate	0.37			
	71-80	18-30	1.40-1.70	0.6-2.0	0.16-0.20	7.9-8.4	Moderate	0.37			
6	0-7	15-26	1.30-1.50	0.6-2.0	0.16-0.24	5.6-7.3	Low	0.43	5	---	1-3
Bethany	7-16	27-35	1.45-1.70	0.2-0.6	0.16-0.20	6.1-7.3	Moderate	0.37			
	16-78	35-50	1.40-1.70	0.06-0.2	0.14-0.18	6.6-8.4	High	0.37			
7	0-10	15-26	1.30-1.50	0.6-2.0	0.16-0.24	5.6-7.3	Low	0.43	5	---	1-3
Bethany	10-20	27-35	1.45-1.70	0.2-0.6	0.16-0.20	6.1-7.3	Moderate	0.37			
	20-81	35-50	1.40-1.70	0.06-0.2	0.14-0.18	6.6-8.4	High	0.37			
8	0-20	40-60	1.40-1.50	<0.06	0.12-0.18	5.6-8.4	High	0.32	5	---	1-3
Burleson	20-66	40-60	1.40-1.60	<0.06	0.12-0.18	7.4-8.4	High	0.32			
9	0-6	10-18	1.30-1.60	2.0-6.0	0.07-0.14	4.5-7.3	Low	0.20	4	---	1-3
Chigley	6-42	35-55	1.35-1.60	0.2-0.6	0.09-0.19	5.1-7.3	Moderate	0.28			
	42-54	30-55	1.35-1.65	0.2-0.6	0.08-0.19	6.1-8.4	Moderate	0.28			
	54-64	30-55	1.35-1.65	0.2-0.6	0.06-0.19	6.6-8.4	Moderate	0.24			
10	0-7	10-18	1.30-1.60	2.0-6.0	0.07-0.14	4.5-7.3	Low	0.20	4	---	1-3
Chigley	7-46	35-55	1.35-1.60	0.2-0.6	0.09-0.19	5.1-7.3	Moderate	0.28			
	46-60	30-55	1.35-1.65	0.2-0.6	0.08-0.19	6.1-8.4	Moderate	0.28			
11*:											
Chigley	0-6	10-18	1.30-1.55	2.0-6.0	0.10-0.17	4.5-7.3	Low	0.32	4	---	1-3
	6-45	35-55	1.35-1.60	0.2-0.6	0.09-0.19	5.1-7.3	Moderate	0.28			
	45-57	30-55	1.35-1.65	0.2-0.6	0.08-0.19	6.1-8.4	Moderate	0.28			
	57-62	30-55	1.35-1.65	0.2-0.6	0.06-0.19	6.6-8.4	Moderate	0.24			
Clarita	0-6	40-60	1.25-1.55	<0.06	0.12-0.20	6.1-8.4	High	0.37	4	---	1-3
	6-50	35-60	1.40-1.70	<0.06	0.12-0.22	7.9-8.4	High	0.37			
	50-60	40-60	1.40-1.70	<0.06	0.12-0.18	7.9-8.4	High	0.37			
12	0-25	40-60	1.25-1.55	<0.06	0.12-0.20	6.1-8.4	High	0.37	4	---	1-3
Clarita	25-45	35-60	1.40-1.70	<0.06	0.12-0.22	7.9-8.4	High	0.37			
	45-80	40-60	1.40-1.70	<0.06	0.12-0.18	7.9-8.4	High	0.37			
13	0-8	40-60	1.25-1.55	<0.06	0.12-0.20	6.1-8.4	High	0.37	4	---	1-3
Clarita	8-40	35-60	1.40-1.70	<0.06	0.12-0.22	7.9-8.4	High	0.37			
	40-60	40-60	1.40-1.70	<0.06	0.12-0.18	7.9-8.4	High	0.37			
14	0-4	40-60	1.25-1.55	<0.06	0.12-0.20	6.1-8.4	High	0.37	4	---	1-3
Clarita	4-40	35-60	1.40-1.70	<0.06	0.12-0.22	7.9-8.4	High	0.37			
	40-60	40-60	1.40-1.70	<0.06	0.12-0.18	7.9-8.4	High	0.37			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Reaction	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
15---------------- Dale	0-22	15-26	1.30-1.50	0.6-2.0	0.15-0.24	6.1-7.8	Low--------	0.37	5	---	1-3
	22-72	18-35	1.40-1.70	0.6-2.0	0.15-0.24	7.4-8.4	Moderate	0.37			
16*:											
Dale------------	0-22	15-26	1.30-1.50	0.6-2.0	0.15-0.24	6.1-7.8	Low--------	0.37	5	---	1-3
	22-72	18-35	1.40-1.70	0.6-2.0	0.15-0.24	7.4-8.4	Moderate	0.37			
Urban land.											
17---------------- Durant	0-12	20-26	1.30-1.60	0.6-2.0	0.15-0.24	5.1-6.5	Low--------	0.49	5	---	1-3
	12-18	35-45	1.45-1.70	<0.06	0.12-0.22	5.1-7.3	Moderate	0.43			
	18-70	40-60	1.35-1.60	<0.06	0.12-0.18	5.6-8.4	High------	0.37			
18---------------- Durant	0-10	20-26	1.30-1.60	0.6-2.0	0.15-0.24	5.1-6.5	Low--------	0.49	5	---	1-3
	10-14	35-45	1.45-1.70	<0.06	0.12-0.22	5.1-7.3	Moderate	0.43			
	14-60	40-60	1.35-1.60	<0.06	0.12-0.18	5.6-8.4	High------	0.37			
19---------------- Durant	0-6	20-26	1.30-1.60	0.6-2.0	0.15-0.24	5.1-6.5	Low--------	0.49	5	---	1-3
	6-60	40-60	1.35-1.60	<0.06	0.12-0.18	5.6-8.4	High------	0.37			
20---------------- Durant	0-3	27-35	1.30-1.60	0.2-0.6	0.15-0.20	5.1-6.5	Moderate	0.43	5	---	1-3
	3-8	35-45	1.45-1.70	<0.06	0.12-0.22	5.1-7.5	Moderate	0.43			
	8-72	40-60	1.35-1.60	<0.06	0.12-0.18	5.6-8.4	High------	0.37			
21---------------- Elandco	0-15	27-35	1.30-1.50	0.6-2.0	0.15-0.22	6.6-8.4	Moderate	0.37	5	---	1-3
	15-60	18-35	1.30-1.50	0.6-2.0	0.15-0.22	7.4-8.4	Moderate	0.43			
22---------------- Galey	0-12	2-10	1.35-1.50	2.0-6.0	0.07-0.11	5.1-6.5	Low--------	0.20	5	2	.5-1
	12-60	18-35	1.45-1.70	0.6-2.0	0.13-0.17	5.1-7.3	Low--------	0.32			
23---------------- Garvin	0-9	30-40	1.30-1.60	0.06-0.2	0.15-0.22	6.6-8.4	Moderate	0.43	5	---	1-3
	9-74	35-60	1.35-1.65	<0.06	0.12-0.22	7.9-9.0	High------	0.37			
24*:											
Garvin-----------	0-10	40-60	1.25-1.45	<0.06	0.12-0.18	6.6-8.4	High------	0.37	5	---	1-3
	10-72	35-60	1.35-1.65	<0.06	0.12-0.22	7.9-9.0	High------	0.37			
Elandco----------	0-15	18-27	1.30-1.50	0.6-2.0	0.15-0.22	6.6-8.4	Moderate	0.43	5	---	1-3
	15-60	18-35	1.30-1.50	0.6-2.0	0.15-0.22	7.4-8.4	Moderate	0.43			
25---------------- Gracemont	0-7	10-18	1.30-1.60	0.6-6.0	0.11-0.15	6.6-8.4	Low--------	0.20	5	---	.5-1
	7-47	10-18	1.45-1.65	0.6-6.0	0.11-0.20	7.9-8.4	Low--------	0.32			
	47-70	10-28	1.45-1.70	0.6-6.0	0.11-0.20	7.9-8.4	Low--------	0.32			
26---------------- Grainola	0-7	27-35	1.30-1.60	0.2-0.6	0.15-0.22	7.4-8.4	Moderate	0.43	3	---	.5-1
	7-25	35-60	1.35-1.65	0.06-0.2	0.10-0.20	7.9-8.4	High------	0.37			
	25-38	35-60	1.35-1.65	0.06-0.2	0.02-0.20	7.9-8.4	High------	0.37			
	38-60	---	---	---	---	---	----------	----			
27---------------- Grainola	0-5	27-35	1.30-1.60	0.2-0.6	0.15-0.22	7.4-8.4	Moderate	0.43	3	---	.5-1
	5-25	35-60	1.35-1.65	0.06-0.2	0.10-0.20	7.9-8.4	High------	0.37			
	25-35	35-60	1.35-1.65	0.06-0.2	0.02-0.20	7.9-8.4	High------	0.37			
	35-60	---	---	---	---	---	----------	----			
28---------------- Grainola	0-6	27-35	1.30-1.60	0.2-0.6	0.08-0.20	7.4-8.4	Moderate	0.37	3	---	.5-1
	6-26	35-60	1.35-1.65	0.06-0.2	0.10-0.20	7.9-8.4	High------	0.37			
	26-60	---	---	---	---	---	----------	----			
29*:											
Grainola---------	0-7	27-35	1.30-1.60	0.2-0.6	0.15-0.22	7.4-8.4	Moderate	0.43	3	---	.5-1
	7-25	35-60	1.35-1.65	0.06-0.2	0.10-0.20	7.9-8.4	High------	0.37			
	25-38	35-60	1.35-1.65	0.06-0.2	0.02-0.20	7.9-8.4	High------	0.37			
	38-60	---	---	---	---	---	----------	----			
Urban land.											
30---------------- Justin	0-14	10-26	1.35-1.55	0.6-2.0	0.15-0.20	6.1-7.3	Low--------	0.37	5	---	1-3
	14-72	18-35	1.40-1.60	0.2-0.6	0.13-0.18	6.1-8.4	Moderate	0.28			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Reaction	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
31 Justin	0-12 12-72	10-26 18-35	1.35-1.55 1.40-1.60	0.6-2.0 0.2-0.6	0.15-0.20 0.13-0.18	6.1-7.3 6.1-8.4	Low Moderate	0.37 0.28	5	---	1-3
32 Keokuk	0-16 16-48 48-80	10-18 10-18 5-18	1.30-1.55 1.30-1.60 1.30-1.60	0.6-2.0 0.6-2.0 0.6-2.0	0.15-0.20 0.15-0.20 0.10-0.20	6.1-8.4 6.1-8.4 7.4-8.4	Low Low Low	0.37 0.37 0.37	5	---	1-3
33*:											
Keokuk	0-16 16-48 48-80	10-18 10-18 5-18	1.30-1.55 1.30-1.60 1.30-1.60	0.6-2.0 0.6-2.0 0.6-2.0	0.15-0.20 0.15-0.20 0.10-0.20	6.1-8.4 6.1-8.4 7.4-8.4	Low Low Low	0.37 0.37 0.37	5	---	1-3
Urban land.											
34 Konawa	0-16 16-45 45-72	5-12 18-30 10-24	1.35-1.50 1.50-1.70 1.50-1.70	6.0-20.0 0.6-2.0 2.0-6.0	0.06-0.10 0.12-0.16 0.11-0.15	5.1-6.5 5.1-6.0 5.1-7.3	Low Low Low	0.20 0.32 0.24	5	2	.5-1
35 Konawa	0-5 5-45 45-60	5-12 18-30 10-24	1.35-1.50 1.50-1.70 1.50-1.70	6.0-20.0 0.6-2.0 2.0-6.0	0.06-0.10 0.12-0.16 0.11-0.15	5.1-6.5 5.1-6.0 5.1-7.3	Low Low Low	0.20 0.32 0.24	5	2	.5-1
36 Konawa	0-4 4-44 44-60	5-12 18-30 10-24	1.35-1.50 1.50-1.70 1.50-1.70	6.0-20.0 0.6-2.0 2.0-6.0	0.06-0.10 0.12-0.16 0.11-0.15	5.1-6.5 5.1-6.0 5.1-7.3	Low Low Low	0.20 0.32 0.24	5	2	.5-1
37 Konawa	0-12 12-54 54-72	5-12 18-30 10-24	1.35-1.50 1.50-1.70 1.50-1.70	6.0-20.0 0.6-2.0 2.0-6.0	0.06-0.10 0.12-0.16 0.11-0.15	5.1-6.5 5.1-6.0 5.1-7.3	Low Low Low	0.20 0.32 0.24	5	2	.5-1
38 Konawa	0-12 12-34 34-72	10-18 18-30 10-24	1.30-1.60 1.50-1.70 1.50-1.70	2.0-6.0 0.6-2.0 2.0-6.0	0.11-0.15 0.12-0.16 0.11-0.15	5.1-6.5 5.1-6.0 5.1-7.3	Low Low Low	0.24 0.32 0.24	5	3	.5-1
39 Konawa	0-3 3-32 32-70	10-18 18-30 10-24	1.30-1.60 1.50-1.70 1.50-1.70	2.0-6.0 0.6-2.0 2.0-6.0	0.11-0.15 0.12-0.16 0.11-0.15	5.1-6.5 5.1-6.0 5.1-7.3	Low Low Low	0.24 0.32 0.24	5	3	.5-1
40 Konawa	0-7 7-50 50-70	10-18 18-30 10-24	1.30-1.60 1.50-1.70 1.50-1.70	2.0-6.0 0.6-2.0 2.0-6.0	0.11-0.15 0.12-0.16 0.11-0.15	5.1-6.5 5.1-6.0 5.1-7.3	Low Low Low	0.24 0.32 0.24	5	3	.5-1
41 Konsil	0-10 10-60 60-64	5-12 18-33 ---	1.35-1.50 1.45-1.70 ---	6.0-20 0.6-2.0 ---	0.07-0.11 0.12-0.19 ---	6.1-7.8 5.1-6.5 ---	Low Low ---	0.20 0.32 ---	5	2	<1
42 Konsil	0-14 14-62 62-70	5-12 18-33 ---	1.35-1.70 1.45-1.70 ---	6.0-20 0.6-2.0 ---	0.07-0.11 0.12-0.19 ---	6.1-7.8 5.1-6.5 ---	Low Low ---	0.20 0.32 ---	5	2	<1
43 Konsil	0-12 12-65 65-80	5-12 18-33 ---	1.35-1.50 1.45-1.70 ---	6.0-20 0.6-2.0 ---	0.07-0.11 0.12-0.19 ---	6.1-7.8 5.1-6.5 ---	Low Low ---	0.20 0.32 ---	5	2	<1
44 Lela	0-24 24-72	40-60 40-60	1.25-1.45 1.35-1.60	<0.06 <0.06	0.10-0.18 0.10-0.14	6.1-8.4 7.4-8.4	High High	0.37 0.37	5	---	1-3
45 Loco	0-6 6-17 17-26	27-35 18-35 ---	1.30-1.60 1.40-1.70 ---	0.6-2.0 0.6-2.0 ---	0.18-0.22 0.16-0.24 ---	7.9-8.4 7.9-8.4 ---	Moderate Moderate ---	0.32 0.37 ---	2	---	1-4
46 Lucien	0-15 15-30	15-25 ---	1.30-1.55 ---	2.0-6.0 ---	0.11-0.24 ---	5.6-8.4 ---	Low ---	0.28 ---	2	---	1-3
47*:											
Lucien	0-12 12-15	15-25 ---	1.30-1.55 ---	2.0-6.0 ---	0.12-0.24 ---	5.6-8.4 ---	Low ---	0.32 ---	2	---	1-3

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Reaction	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
47*:											
Nash------------	0-28	10-18	1.35-1.65	0.6-2.0	0.13-0.24	6.1-8.4	Low-------	0.37	3	---	1-3
	28-32	---	---	---	---	---	----------	----			
48--------------- McLain	0-15	27-35	1.30-1.60	0.2-0.6	0.15-0.22	6.1-8.4	Moderate	0.37	5	---	1-3
	15-40	35-50	1.45-1.70	0.06-0.2	0.12-0.22	6.1-8.4	High------	0.37			
	40-72	20-45	1.40-1.70	0.06-0.6	0.12-0.24	6.6-8.4	High------	0.43			
49*:											
McLain----------	0-15	27-35	1.30-1.60	0.2-0.6	0.15-0.22	6.1-8.4	Moderate	0.37	5	---	1-3
	15-40	35-50	1.45-1.70	0.06-0.2	0.12-0.22	6.1-8.4	High------	0.37			
	40-72	20-45	1.40-1.70	0.06-0.6	0.12-0.24	6.6-8.4	High------	0.43			
Urban land.											
50--------------- Newalla	0-8	7-17	1.30-1.60	0.6-2.0	0.11-0.15	4.5-7.3	Low-------	0.37	4	---	.5-3
	8-12	20-35	1.45-1.70	0.6-2.0	0.12-0.20	4.5-7.3	Low-------	0.43			
	12-38	40-60	1.35-1.60	<0.06	0.12-0.18	4.5-8.4	High------	0.37			
	38-50	40-60	1.35-1.60	<0.06	0.08-0.18	7.4-8.4	High------	0.37			
	50-65	---	---	---	---	---	----------	----			
51--------------- Newalla	0-8	7-17	1.30-1.60	0.6-2.0	0.11-0.15	4.5-7.3	Low-------	0.37	4	---	.5-3
	8-18	20-35	1.45-1.70	0.6-2.0	0.12-0.20	4.5-7.3	Low-------	0.43			
	18-54	40-60	1.35-1.60	<0.06	0.12-0.18	4.5-8.4	High------	0.37			
	54-60	---	---	---	---	---	----------	----			
52--------------- Newalla	0-4	7-17	1.30-1.60	0.6-2.0	0.11-0.15	4.5-7.3	Low-------	0.37	4	---	.5-3
	4-12	20-35	1.45-1.70	0.6-2.0	0.12-0.20	4.5-7.3	Low-------	0.43			
	12-23	40-60	1.35-1.60	<0.06	0.12-0.18	4.5-8.4	High------	0.37			
	23-40	40-60	1.35-1.60	<0.06	0.08-0.18	7.4-8.4	High------	0.37			
	40-51	---	---	---	---	---	----------	----			
53--------------- Norge	0-11	15-26	1.30-1.50	0.6-2.0	0.15-0.24	5.6-7.3	Low-------	0.37	5	---	1-3
	11-17	18-35	1.40-1.70	0.2-2.0	0.15-0.24	5.6-7.3	Moderate	0.32			
	17-45	27-35	1.45-1.70	0.2-0.6	0.15-0.22	5.6-7.8	Moderate	0.32			
	45-72	27-39	1.45-1.70	0.2-0.6	0.15-0.22	6.1-8.4	Moderate	0.32			
54--------------- Norge	0-10	15-26	1.30-1.50	0.6-2.0	0.15-0.24	5.6-7.3	Low-------	0.37	5	---	1-3
	10-18	18-35	1.40-1.70	0.2-2.0	0.15-0.24	5.6-7.3	Moderate	0.32			
	18-45	27-35	1.45-1.70	0.2-0.6	0.15-0.22	5.6-7.8	Moderate	0.32			
	45-72	27-39	1.45-1.70	0.2-0.6	0.15-0.22	6.1-8.4	Moderate	0.32			
55*. Oil-wasteland											
56--------------- Port	0-14	10-18	1.30-1.60	0.6-2.0	0.11-0.20	5.6-7.8	Low-------	0.24	5	---	.5-1
	14-72	20-35	1.30-1.60	0.6-2.0	0.15-0.24	6.1-8.4	Moderate	0.37			
57--------------- Port	0-27	12-26	1.30-1.55	0.6-2.0	0.15-0.24	5.6-7.8	Low-------	0.37	5	---	1-3
	27-72	20-35	1.30-1.60	0.6-2.0	0.15-0.24	6.1-8.4	Moderate	0.37			
58*:											
Port------------	0-23	12-26	1.30-1.55	0.6-2.0	0.15-0.24	5.6-7.8	Low-------	0.37	5	---	1-3
	23-60	20-35	1.30-1.60	0.6-2.0	0.15-0.24	6.1-8.4	Moderate	0.37			
Pulaski---------	0-9	10-18	1.30-1.60	2.0-6.0	0.11-0.20	5.6-7.3	Low-------	0.20	5	---	.5-1
	9-20	10-18	1.40-1.70	2.0-6.0	0.11-0.20	5.6-7.3	Low-------	0.32			
	20-60	5-18	1.50-1.70	2.0-6.0	0.07-0.20	5.6-8.4	Low-------	0.32			
59--------------- Pulaski	0-12	10-18	1.30-1.60	2.0-6.0	0.11-0.20	5.6-7.3	Low-------	0.20	5	---	.5-1
	12-46	10-18	1.40-1.70	2.0-6.0	0.11-0.20	5.6-7.3	Low-------	0.32			
	46-65	5-18	1.50-1.70	2.0-6.0	0.07-0.20	5.6-8.4	Low-------	0.32			
60--------------- Rayford	0-5	18-26	1.30-1.55	0.6-2.0	0.10-0.15	6.6-8.4	Low-------	0.28	1	---	1-3
	5-12	18-35	1.40-1.70	0.6-2.0	0.07-0.12	7.9-8.4	Moderate	0.24			
	12-14	---	---	---	---	---	----------	----			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Reaction	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
61---------------- Renfrow	0-8	18-26	1.30-1.55	0.6-2.0	0.15-0.24	6.1-7.8	Low--------	0.49	4	---	1-3
	8-13	32-40	1.45-1.70	0.2-0.6	0.15-0.20	6.1-7.8	Moderate	0.43			
	13-61	35-55	1.40-1.70	<0.06	0.12-0.18	6.1-8.4	High-------	0.43			
	61-64	---	---	---	---	---	-----------	----		---	
62---------------- Renfrow	0-11	18-26	1.30-1.55	0.6-2.0	0.15-0.24	6.1-7.8	Low--------	0.49	4	---	1-3
	11-16	32-40	1.45-1.70	0.2-0.6	0.15-0.20	6.1-7.8	Moderate	0.43			
	16-65	35-55	1.40-1.70	<0.06	0.12-0.18	6.1-8.4	High-------	0.43			
	65-72	---	---	---	---	---	-----------	----		---	
63---------------- Renfrow	0-7	18-26	1.30-1.55	0.6-2.0	0.15-0.24	6.1-7.8	Low--------	0.49	4	---	1-3
	7-63	35-55	1.40-1.70	<0.06	0.12-0.18	6.1-8.4	High-------	0.43			
64---------------- Renfrow	0-5	18-26	1.30-1.55	0.6-2.0	0.15-0.24	6.1-7.8	Low--------	0.49	4	---	1-3
	5-62	35-55	1.40-1.70	<0.06	0.12-0.18	6.1-8.4	High-------	0.43			
65*:											
Renfrow----------	0-8	18-26	1.30-1.55	0.6-2.0	0.15-0.24	6.1-7.8	Low--------	0.49	4	---	1-3
	8-13	32-40	1.45-1.70	0.2-0.6	0.15-0.20	6.1-7.8	Moderate	0.43			
	13-65	35-55	1.40-1.70	<0.06	0.12-0.18	6.1-8.4	High-------	0.43			
Urban land.											
66---------------- Stephenville	0-8	10-20	1.30-1.60	2.0-6.0	0.11-0.15	5.1-6.5	Low--------	0.24	3	---	<1
	8-34	18-35	1.50-1.70	0.6-2.0	0.11-0.17	4.5-6.0	Low--------	0.32			
	34-36	---	---	---	---	---	-----------	----			
67---------------- Stephenville	0-9	10-20	1.30-1.60	2.0-6.0	0.11-0.15	5.1-6.5	Low--------	0.24	3	---	<1
	9-35	18-35	1.50-1.70	0.6-2.0	0.11-0.17	4.5-6.0	Low--------	0.32			
	35-44	---	---	---	---	---	-----------	----			
68---------------- Stephenville	0-6	10-20	1.30-1.60	2.0-6.0	0.11-0.15	5.1-6.5	Low--------	0.24	3	---	<1
	6-33	18-35	1.50-1.70	0.6-2.0	0.11-0.17	4.5-6.0	Low--------	0.32			
	33-38	---	---	---	---	---	-----------	----			
69*:											
Stephenville-----	0-6	10-20	1.30-1.60	2.0-6.0	0.08-0.15	5.1-6.5	Low--------	0.20	3	---	<1
	6-24	18-35	1.50-1.70	0.6-2.0	0.11-0.17	4.5-6.0	Low--------	0.32			
	24-30	---	---	---	---	---	-----------	----			
Darnell----------	0-4	10-20	1.30-1.65	2.0-6.0	0.12-0.16	5.1-7.3	Low--------	0.20	2	---	<1
	4-10	10-25	1.40-1.70	2.0-6.0	0.12-0.16	5.1-7.3	Low--------	0.32			
	10-15	---	---	---	---	---	-----------	----			
70*:											
Stephenville-----	0-5	10-20	1.30-1.60	2.0-6.0	0.11-0.15	5.1-6.5	Low--------	0.24	3	---	<1
	5-36	18-35	1.50-1.70	0.6-2.0	0.11-0.17	4.5-6.0	Low--------	0.32			
	36-40	---	---	---	---	---	-----------	----			
Newalla----------	0-4	7-17	1.30-1.60	0.6-2.0	0.11-0.15	4.5-7.3	Low--------	0.37	4	---	.5-3
	4-36	40-60	1.35-1.60	<0.06	0.12-0.18	4.5-8.4	High-------	0.37			
	36-42	40-60	1.35-1.60	<0.06	0.08-0.18	7.4-8.4	High-------	0.37			
	42-50	---	---	---	---	---	-----------	----			
71---------------- Teller	0-5	10-18	1.30-1.60	2.0-6.0	0.11-0.15	5.6-7.3	Low--------	0.24	5	---	1-3
	5-50	18-30	1.45-1.70	0.6-2.0	0.14-0.18	5.6-7.3	Low--------	0.32			
	50-64	10-20	1.30-1.60	2.0-6.0	0.13-0.17	5.6-7.3	Low--------	0.32			
72---------------- Teller	0-8	10-18	1.30-1.60	2.0-6.0	0.11-0.15	5.6-7.3	Low--------	0.24	5	---	1-3
	8-32	18-30	1.45-1.70	0.6-2.0	0.14-0.18	5.6-7.3	Low--------	0.32			
	32-70	10-20	1.30-1.60	2.0-6.0	0.13-0.17	5.6-7.3	Low--------	0.32			
73---------------- Teller	0-15	10-18	1.30-1.60	2.0-6.0	0.11-0.15	5.6-7.3	Low--------	0.24	5	---	1-3
	15-38	18-30	1.45-1.70	0.6-2.0	0.14-0.18	5.6-7.3	Low--------	0.32			
	38-66	10-20	1.30-1.60	2.0-6.0	0.13-0.17	5.6-7.3	Low--------	0.32			
74---------------- Teller	0-18	10-20	1.30-1.55	2.0-6.0	0.12-0.16	5.6-7.3	Low--------	0.37	5	---	1-3
	18-40	18-30	1.45-1.70	0.6-2.0	0.14-0.18	5.6-7.3	Low--------	0.32			
	40-75	10-20	1.30-1.60	2.0-6.0	0.13-0.17	5.6-7.3	Low--------	0.32			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm^3	In/hr	In/in	pH					Pct
75----------------	0-12	10-20	1.30-1.55	2.0-6.0	0.12-0.16	5.6-7.3	Low--------	0.37	5	---	1-3
Teller	12-56	18-30	1.45-1.70	0.6-2.0	0.14-0.18	5.6-7.3	Low--------	0.32			
	56-66	10-20	1.30-1.60	2.0-6.0	0.13-0.17	5.6-7.3	Low--------	0.32			
76----------------	0-16	10-20	1.30-1.55	2.0-6.0	0.12-0.16	5.6-7.3	Low--------	0.37	5	---	1-3
Teller	16-52	18-30	1.45-1.70	0.6-2.0	0.14-0.18	5.6-7.3	Low--------	0.32			
	52-70	10-20	1.30-1.60	2.0-6.0	0.13-0.17	5.6-7.3	Low--------	0.32			
78*:											
Teller-----------	0-16	10-20	1.30-1.55	2.0-6.0	0.12-0.16	5.6-7.3	Low--------	0.37	5	---	1-3
	16-52	18-30	1.45-1.70	0.6-2.0	0.14-0.18	5.6-7.3	Low--------	0.32			
	52-70	10-20	1.30-1.60	2.0-6.0	0.13-0.17	5.6-7.3	Low--------	0.32			
Urban land.											
79----------------	0-6	40-50	1.25-1.45	<0.06	0.10-0.18	7.4-8.4	High-------	0.37	3	---	.5-3
Tussy	6-32	40-60	1.35-1.60	<0.06	0.10-0.18	7.9-8.4	High-------	0.37			
	32-60	35-50	1.35-1.70	<0.06	0.07-0.15	7.9-8.4	High-------	0.37			
80----------------	0-8	40-50	1.25-1.45	<0.06	0.10-0.18	7.4-8.4	High-------	0.37	3	---	.5-3
Tussy	8-32	40-60	1.35-1.60	<0.06	0.10-0.18	7.9-8.4	High-------	0.37			
	32-60	35-50	1.35-1.70	<0.06	0.07-0.15	7.9-8.4	High-------	0.37			
81*											
Urban land											
82----------------	0-12	15-26	1.30-1.50	0.6-2.0	0.15-0.24	5.1-7.3	Low--------	0.37	5	---	1-3
Vanoss	12-24	18-30	1.40-1.70	0.6-2.0	0.15-0.24	5.1-7.3	Moderate	0.32			
	24-44	27-35	1.45-1.70	0.6-2.0	0.15-0.22	5.1-7.3	Moderate	0.32			
	44-58	18-35	1.40-1.70	0.6-2.0	0.15-0.24	5.6-8.4	Moderate	0.32			
	58-64	10-35	1.40-1.70	0.6-2.0	0.11-0.24	5.6-8.4	Low--------	0.32			
83----------------	0-8	18-27	1.40-1.65	0.2-0.6	0.15-0.20	5.6-7.3	Low--------	0.43	5	---	.5-2
Wilson	8-40	35-50	1.50-1.70	<0.06	0.14-0.20	5.6-8.4	High-------	0.37			
	40-60	35-60	1.50-1.70	<0.06	0.12-0.15	6.6-8.4	High-------	0.37			
84----------------	0-12	10-18	1.30-1.60	2.0-6.0	0.11-0.15	7.4-8.4	Low--------	0.20	5	3	.5-1
Yahola	12-42	5-18	1.40-1.70	2.0-6.0	0.11-0.20	7.9-8.4	Low--------	0.20			
	42-63	2-30	1.45-1.70	2.0-6.0	0.07-0.20	7.9-8.4	Low--------	0.20			
85*:											
Yahola-----------	0-5	10-18	1.30-1.60	2.0-6.0	0.11-0.15	7.4-8.4	Low--------	0.20	5	3	.5-1
	5-42	5-18	1.40-1.70	2.0-6.0	0.11-0.20	7.9-8.4	Low--------	0.20			
	42-70	2-30	1.45-1.70	2.0-6.0	0.07-0.20	7.9-8.4	Low--------	0.20			
Gaddy------------	0-10	5-15	1.35-1.50	6.0-20	0.07-0.11	7.4-8.4	Low--------	0.17	5	2	<.5
	10-60	5-15	1.50-1.70	6.0-20	0.06-0.10	7.9-8.4	Low--------	0.17			
86----------------	0-12	15-22	1.30-1.60	0.6-2.0	0.15-0.20	5.6-7.3	Low--------	0.37	4	---	1-3
Zaneis	12-16	18-30	1.40-1.70	0.6-2.0	0.12-0.20	5.6-7.3	Low--------	0.37			
	16-42	20-38	1.45-1.70	0.2-0.6	0.12-0.20	5.6-7.3	Moderate	0.32			
	42-54	15-30	1.40-1.70	0.6-2.0	0.11-0.20	6.1-7.8	Low--------	0.32			
	54-60	---	---	---	---	---	-----------	----			
87----------------	0-10	15-22	1.30-1.60	0.6-2.0	0.15-0.20	5.6-7.3	Low--------	0.37	4	---	1-3
Zaneis	10-18	18-30	1.40-1.70	0.6-2.0	0.12-0.20	5.6-7.3	Low--------	0.37			
	18-51	20-38	1.45-1.70	0.2-0.6	0.12-0.20	5.6-7.3	Moderate	0.32			
	51-57	15-30	1.40-1.70	0.6-2.0	0.11-0.20	6.1-7.8	Low--------	0.32			
	57-62	---	---	---	---	---	-----------	----			
88----------------	0-6	15-22	1.30-1.60	0.6-2.0	0.15-0.20	5.6-7.3	Low--------	0.37	4	---	1-3
Zaneis	6-11	18-30	1.40-1.70	0.6-2.0	0.12-0.20	5.6-7.3	Low--------	0.37			
	11-51	20-38	1.45-1.70	0.2-0.6	0.12-0.20	5.6-7.3	Moderate	0.32			
	51-57	15-30	1.40-1.70	0.6-2.0	0.11-0.20	6.1-7.8	Low--------	0.32			
	57-62	---	---	---	---	---	-----------	----			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
89----------------- Zaneis	0-6	15-22	1.30-1.60	0.6-2.0	0.15-0.20	5.6-7.3	Low--------	0.37	4	---	1-3
	6-10	18-30	1.40-1.70	0.6-2.0	0.12-0.20	5.6-7.3	Low--------	0.37			
	10-36	20-38	1.45-1.70	0.2-0.6	0.12-0.20	5.6-7.3	Moderate	0.32			
	36-45	15-30	1.40-1.70	0.6-2.0	0.11-0.20	6.1-7.8	Low--------	0.32			
	45-62	---	---	---	---	---	-----------	----			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern]

Map symbol and soil name	Hydro-logic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	Uncoated steel	Concrete
					Ft			In			
1------------------ Amber	B	Rare---------	---	---	>6.0	---	---	>60	---	Low-------	Low.
2------------------ Asa	B	Occasional	Very brief to brief.	Mar-Oct	>6.0	---	---	>60	---	High------	Low.
3------------------ Asher	C	Rare---------	---	---	>6.0	---	---	>60	---	High------	Low.
4*:											
Asher-------------	C	Rare---------	---	---	>6.0	---	---	>60	---	High------	Low.
Urban land.											
5------------------ Bergstrom	B	Occasional	Very brief to brief.	Mar-Oct	>6.0	---	---	>60	---	Moderate	Low.
6, 7--------------- Bethany	C	None---------	---	---	>6.0	---	---	>60	---	High------	Low.
8------------------ Burleson	D	None---------	---	---	>6.0	---	---	>60	---	High------	Low.
9, 10-------------- Chigley	C	None---------	---	---	3.0-4.0	Perched	Feb-May	>60	---	High------	Moderate.
11*:											
Chigley-----------	C	None---------	---	---	3.0-4.0	Perched	Feb-May	>60	---	High------	Moderate.
Clarita-----------	D	None---------	---	---	>6.0	---	---	>60	---	High------	Low.
12, 13, 14--------- Clarita	D	None---------	---	---	>6.0	---	---	>60	---	High------	Low.
15----------------- Dale	B	Rare---------	---	---	>6.0	---	---	>60	---	Moderate	Low.
16*:											
Dale--------------	B	Rare---------	---	---	>6.0	---	---	>60	---	Moderate	Low.
Urban land.											
17, 18, 19, 20----- Durant	D	None---------	---	---	>6.0	---	---	>60	---	High------	Moderate.
21----------------- Elandco	B	Occasional	Very brief to brief.	Mar-Oct	>6.0	---	---	>60	---	Moderate	Low.
22----------------- Galey	B	None---------	---	---	4.0-6.0	Perched	Mar-May	>60	---	Moderate	Moderate.
23----------------- Garvin	D	Occasional	Very brief to brief.	Mar-Oct	>6.0	---	---	>60	---	High------	Low.
24*:											
Garvin------------	D	Frequent----	Very brief to brief.	Mar-Oct	>6.0	---	---	>60	---	High------	Low.
Elandco-----------	B	Frequent----	Very brief to brief.	Mar-Oct	>6.0	---	---	>60	---	Moderate	Low.
25----------------- Gracemont	C	Occasional	Very brief to brief.	Mar-Oct	0.5-3.0	Apparent	Nov-May	>60	---	Moderate	Low.
26, 27, 28--------- Grainola	D	None---------	---	---	>6.0	---	---	20-40	Soft	High------	Low.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Map symbol and soil name	Hydro-logic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	Uncoated steel	Concrete
					Ft			In			
29*:											
Grainola----------	D	None--------	---	---	>6.0	---	---	20-40	Soft	High-----	Low.
Urban land.											
30, 31------------ Justin	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low.
32---------------- Keokuk	B	Rare--------	---	---	>6.0	---	---	>60	---	Low------	Low.
33*:											
Keokuk------------	B	Rare--------	---	---	>6.0	---	---	>60	---	Low------	Low.
Urban land.											
34, 35, 36, 37, 38, 39, 40------- Konawa	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate.
41, 42, 43-------- Konsil	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate.
44---------------- Lela	D	Rare--------	---	---	>6.0	---	---	>60	---	High-----	Low.
45---------------- Loco	C	None--------	---	---	>6.0	---	---	10-20	Soft	Low------	Low.
46---------------- Lucien	C	None--------	---	---	>6.0	---	---	10-20	Soft	Low------	Low.
47*:											
Lucien------------	C	None--------	---	---	>6.0	---	---	10-20	Soft	Low------	Low.
Nash--------------	B	None--------	---	---	>6.0	---	---	20-40	Soft	Low------	Low.
48---------------- McLain	C	Rare--------	---	---	>6.0	---	---	>60	---	High-----	Low.
49*:											
McLain------------	C	Rare--------	---	---	>6.0	---	---	>60	---	High-----	Low.
Urban land.											
50, 51, 52-------- Newalla	D	None--------	---	---	>6.0	---	---	40-60	Soft	High-----	Moderate.
53, 54------------ Norge	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low.
55*. Oil-wasteland											
56, 57------------ Port	B	Occasional	Very brief to brief.	Mar-Oct	>6.0	---	---	>60	---	Moderate	Low.
58*:											
Port--------------	B	Frequent----	Very brief to brief.	Mar-Oct	>6.0	---	---	>60	---	Moderate	Low.
Pulaski-----------	B	Frequent----	Very brief	Mar-Oct	>6.0	---	---	>60	---	Low------	Moderate.
59---------------- Pulaski	B	Occasional	Very brief	Mar-Oct	>6.0	---	---	>60	---	Low------	Moderate.
60---------------- Rayford	C	None--------	---	---	>6.0	---	---	8-20	Hard	Moderate	Low.
61, 62, 63, 64---- Renfrow	D	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Map symbol and soil name	Hydro-logic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	Uncoated steel	Concrete
					Ft			In			
65*:											
Renfrow----------	D	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
Urban land.											
66, 67, 68-------- Stephenville	B	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate.
69*:											
Stephenville-----	B	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate.
Darnell----------	C	None--------	---	---	>6.0	---	---	10-20	Soft	Low------	Moderate.
70*:											
Stephenville-----	B	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate.
Newalla----------	D	None--------	---	---	>6.0	---	---	40-60	Soft	High-----	Moderate.
71, 72, 73, 74, 75, 76----------- Teller	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate.
78*:											
Teller-----------	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate.
Urban land.											
79, 80------------ Tussy	D	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
81*. Urban land											
82---------------- Vanoss	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate.
83---------------- Wilson	D	None--------	---	---	0-2.0	Perched	Nov-Mar	>60	---	High-----	High.
84---------------- Yahola	B	Occasional	Very brief	Mar-Oct	>6.0	---	---	>60	---	Low------	Low.
85*:											
Yahola-----------	B	Frequent----	Very brief	Mar-Oct	>6.0	---	---	>60	---	Low------	Low.
Gaddy------------	A	Frequent----	Very brief	Mar-Oct	>6.0	---	---	>60	---	Low------	Low.
86, 87, 88, 89---- Zaneis	B	None--------	---	---	>6.0	---	---	40-60	Soft	Moderate	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--PHYSICAL ANALYSES OF SELECTED SOILS

Soil series and sample number	Depth	Horizon	Particle-size distribution: Very coarse sand (2.0-1.0 mm)	Coarse sand (1.0-0.5 mm)	Medium sand (0.5-0.25 mm)	Fine sand (0.25-0.10 mm)	Very fine sand (0.10-0.05 mm)	Total sand (2.0-0.05 mm)	Silt (0.05-0.002 mm	Clay (0.002 mm)
	In		Pct	Pct	Pct	Pct	Pct	Pct	Pct	Pct
Clarita:1/ (77-OK-49-3)	0-6	A	1.1	2.0	2.3	3.3	2.3	11.0	38.0	51.0
	6-20	AC1	0.6	1.3	1.6	2.4	2.1	8.0	34.4	57.6
	20-43	AC2	0.8	1.1	1.4	1.9	1.6	6.8	33.3	59.9
	43-60	C	0.7	1.8	5.0	3.3	2.7	13.5	36.4	50.1
Garvin silty clay loam:2/ 80-OK-49-7	0-9	Ap	0.4	0.8	2.6	7.5	7.9	19.2	48.4	32.4
	9-32	A1	0.3	0.6	2.6	7.0	6.5	17.0	40.7	42.3
	32-65	B2	0.9	3.4	10.5	11.2	4.8	30.8	33.1	36.1
	65-74	C	0.9	1.9	4.5	7.3	5.1	19.7	39.9	40.4
Gracemont:3/ 76-OK-49-1	0-7	A1	0.0	0.1	0.6	33.7	14.4	52.2	35.8	12.0
	7-29	C1	0.0	0.1	0.3	15.1	43.7	59.2	32.0	8.8
	29-47	C2	0.0	0.1	0.3	28.4	36.7	65.5	26.3	8.2
	47-70	Ab	0.0	1.0	0.6	9.1	14.0	24.7	50.3	25.0
Konawa fine sandy loam:4/ 80-OK-42-21	0-9	Ap	0.9	4.6	33.6	33.5	6.1	78.7	8.5	12.8
	9-14	A2	1.3	7.8	32.8	34.9	5.5	82.3	10.8	6.9
	14-21	B21t	1.2	7.5	25.4	26.3	4.4	64.8	0.2	35.0
	21-36	B22t	0.5	3.8	23.7	30.7	5.0	63.7	6.3	30.0
	36-59	B3	0.4	3.9	32.9	31.9	5.8	74.9	2.6	22.5
	59-85	C	0.1	0.9	17.7	45.3	7.5	71.5	4.8	23.7
Konawa loamy sand:5/ 80-OK-49-21	0-8	Ap	1.3	10.6	39.5	28.2	4.2	83.8	10.6	5.6
	8-16	A2	1.3	9.6	37.4	31.0	5.2	84.5	5.4	10.1
	16-20	B21t	0.9	7.2	27.5	23.4	4.0	63.0	6.4	30.6
	20-48	B22t	0.1	3.5	26.4	32.9	4.9	67.8	2.2	30.0
	48-59	B3	0.4	6.6	29.3	30.8	4.7	71.8	0.0	28.2
	59-86	C	0.3	4.1	26.8	38.2	6.1	75.5	0.7	23.8
Konawa fine sandy loam:6/ 80-OK-49-2	0-6	Ap	0.1	0.1	1.3	30.1	16.4	48.0	37.0	15.0
	6-32	B21t	0.1	0.1	3.8	21.9	10.5	36.4	31.0	32.6
	32-53	B22t	0.1	0.2	2.0	33.9	11.4	47.6	23.9	28.5
	53-65	B3	0.3	0.2	12.5	32.6	8.1	53.7	21.0	25.3
Konawa fine sandy loam:7/ 80-OK-49-1	0-5	Ap	0.2	0.2	2.9	49.2	17.2	69.7	17.5	12.8
	5-20	B21t	0.2	0.2	2.5	40.8	10.7	54.4	17.3	28.3
	20-51	B22t	0.1	0.1	2.5	36.9	17.2	56.8	18.6	24.6
	51-65	B3	0.1	0.1	1.3	44.2	16.4	62.1	17.9	20.0
Konawa fine sandy loam:8/ 80-OK-49-3	0-3	Ap	0.1	0.3	3.2	55.4	10.4	69.4	13.6	17.0
	3-14	B21t	0.1	0.1	3.3	42.2	6.6	52.3	13.9	33.8
	14-38	B22t	0.1	0.2	2.5	50.1	8.1	61.0	12.0	27.0
	38-71	B3	0.1	0.1	5.6	54.3	8.4	68.5	9.6	21.9
Loco silty clay loam:9/ 77-OK-49-1	0-6	A	0.2	0.4	0.5	3.5	14.5	19.1	50.2	30.7
	6-17	B2	0.3	0.4	0.4	1.9	7.6	10.6	53.0	36.4
	17-26	Cr	0.3	0.2	0.5	2.6	4.4	8.0	55.7	36.3

See footnote at end of table.

TABLE 18.--PHYSICAL ANALYSES OF SELECTED SOILS--Continued

Soil series and sample number	Depth	Horizon	Particle-size distribution							
			Very coarse sand (2.0-1.0 mm)	Coarse sand (1.0-0.5 mm)	Medium sand (0.5-0.25 mm)	Fine sand (0.25-0.10 mm)	Very fine sand (0.10-0.05 mm)	Total sand (2.0-0.05 mm)	Silt (0.05-0.002 mm	Clay (0.002 mm)
	In		Pct	Pct	Pct	Pct	Pct	Pct	Pct	Pct
Stephenville fine sandy loam:10/ 77-OK-49-2	0-4	A1	0.2	0.9	7.2	46.9	11.7	66.9	21.6	11.5
	4-16	B21t	1.1	2.8	11.7	35.4	9.0	60.0	17.9	22.1
	16-21	B22t	0.1	0.2	3.4	65.1	8.1	76.9	11.7	11.4
Teller loam:11/ 80-OK-49-6	0-4	Ap	0.1	0.2	0.6	19.3	17.0	37.2	44.9	17.7
	4-8	B1	0.1	0.3	0.8	16.5	13.7	31.4	44.9	23.7
	8-32	B21t	0.1	0.1	0.5	16.8	13.8	31.3	36.6	32.1
	32-45	B22t	0.2	0.1	0.5	27.3	12.2	40.3	27.0	32.7
	45-66	B3	0.7	0.2	0.6	27.4	16.3	45.2	29.5	25.3
Tussy clay:12/ 77-OK-49-5	0-4	A11	2.4	5.6	4.4	6.4	3.9	22.7	37.3	40.0
	4-8	A12	0.7	2.2	3.3	5.0	3.6	14.8	47.7	37.5
	8-16	B2	0.3	0.6	0.7	1.2	1.4	4.2	44.5	51.3
	16-32	B2	0.2	0.5	0.7	2.0	2.8	6.2	49.5	44.3
	32-60	C	0.2	0.3	0.2	0.2	0.8	1.7	61.8	36.5

1/Clarita clay:
2,000 feet south and 600 feet east of northwest corner of sec. 3, T. 2 N., R. 2 E. This pedon is a taxadjunct to the Clarita series because the A horizon has chroma of 2 within a depth of 12 inches in most pedons.

2/Garvin silty clay loam:
Typical pedon for the series.

3/Gracemont fine sandy loam:
Typical pedon for the series.

4/Konawa fine sandy loam:
1,350 feet south and 25 feet west of northeast corner of sec. 10, T. 4 N., R. 3 E.

5/Konawa loamy sand:
1,325 feet south and 20 feet west of northwest corner of sec. 10, T. 4 N., R. 3 E.

6/Konawa fine sandy loam:
2,500 feet south and 750 feet east of northwest corner of sec. 32, T. 4 N., R. 1 E. This pedon is a taxadjunct to the Konawa series because the A horizon is slightly more clayey than allowed for the series.

7/Konawa fine sandy loam:
3,600 feet north and 950 feet east of southwest corner of sec. 34, T. 2 N., R. 3 W.

8/Konawa fine sandy loam:
1,833 feet south and 100 feet east of northwest corner of sec. 32, T. 4 N., R. 1 E.

9/Loco silty clay loam:
Typical pedon for the series.

10/Stephenville fine sandy loam:
950 feet south and 300 feet east of the northwest corner of sec. 8, T. 3 N., R. 4 W. This pedon is a taxadjunct to the Stephenville series because the base saturation of the argillic horizon is 78 percent and the pH is more than 6.0.

11/Teller loam:
200 feet south and 3,500 feet west of northeast corner of sec. 28, T. 2 N., R. 3 W. This pedon is a taxadjunct to the Teller series because the A horizon is too thin for a mollic epipedon. The mollic colors are slightly too thin for a mollic epipedon, which is outside the range of the Teller series.

12/Tussy clay:
Typical pedon for the series. The B2 horizon was subdivided for sampling purposes.

TABLE 19.--CHEMICAL ANALYSES OF SELECTED SOILS

Soil series and sample number	Depth	Horizon	Extractable bases (milliequivalents per 100 grams of soil)				Cation-exchange capacity	Base saturation	Reaction (1.1 soil-water)	Organic matter	Total phosphorus
			Ca	Mg	K	Na					
	In							Pct	pH	Pct	P/M
Clarita clay:1/											
(77-OK-49-3)	0-6	A1	35.65	21.85	0.47	0.36	60.5	93.5	7.2	2.57	70.0
	6-20	AC1	56.81	26.45	0.31	1.48	57.1	97.8	7.9	1.15	70.0
	20-43	AC2	53.82	31.97	0.40	5.17	58.3	97.8	8.2	1.00	65.0
	43-60	C	71.07	16.56	0.21	3.75	61.0	98.1	8.2	0.94	335.0
Garvin:2/											
80-OK-49-7	0-9	Ap	25.34	8.86	0.61	0.09	42.0	86.8	6.7	2.41	N/A
	9-32	A1	30.49	10.71	0.35	1.94	45.1	91.2	7.0	2.32	N/A
	32-65	B2	35.84	16.89	0.24	10.63	38.1	100.0	8.6	.49	N/A
	65-74	C	39.14	16.89	0.30	11.53	43.2	100.0	8.4	.50	N/A
Gracement fine sandy loam:3/											
76-OK-49-1	0-7	A1	15.09	0.55	0.54	0.13	9.8	92.7	7.8	1.94	0.1
	7-29	C1	16.01	3.31	0.26	0.14	6.9	98.7	8.1	0.46	0.1
	29-47	C2	34.04	1.47	0.31	0.16	7.1	100.0	8.1	0.50	0.1
	47-70	Ab	28.06	3.68	0.31	0.25	17.1	96.9	8.1	1.42	0.1
Konawa fine sandy loam:4/											
80-OK-49-20	0-9	Ap	0.85	0.80	0.15	0.18	8.9	54.4	5.8	1.07	N/A
	9-14	A2	0.91	0.51	0.12	0.11	7.3	59.8	6.0	0.37	N/A
	14-21	B21t	4.74	3.87	0.39	0.07	17.4	66.0	5.0	0.61	N/A
	21-36	B22t	3.30	3.30	0.26	0.20	21.6	53.1	5.0	0.35	N/A
	36-59	B3	3.30	3.95	0.26	0.08	15.6	57.2	5.2	0.21	N/A
	59-85	C	2.93	2.88	0.23	0.18	15.9	58.4	6.0	0.22	N/A
Konawa loamy sand:5/											
80-OK-49-21-1	0-8	Ap	0.85	0.80	0.15	0.18	8.9	54.4	5.8	1.07	N/A
	8-16	A2	0.91	0.51	0.12	0.11	7.3	59.8	6.0	0.37	N/A
	16-20	B21t	4.74	3.87	0.39	0.07	17.4	66.0	5.0	0.61	N/A
	20-48	B22t	3.30	3.30	0.26	0.20	21.6	53.1	5.0	0.35	N/A
	48-59	B3	3.30	3.95	0.26	0.08	15.6	57.2	5.2	0.21	N/A
	59-86	C	2.93	2.88	0.23	0.18	15.9	58.4	6.0	0.22	N/A
Konawa fine sandy loam:6/											
80-OK-49-2	0-6	Ap	3.00	1.44	0.43	0.03	6.4	51.5	6.0	1.81	253.0
	-	B21t	4.22	3.38	0.34	0.03	16.0	49.7	5.2	1.21	253.0
	-	B22t	4.37	4.31	0.28	0.07	15.7	63.8	5.4	0.95	229.0
	-	B3	4.83	3.65	0.29	0.09	13.7	69.7	5.6	0.63	205.0
Konawa fine sandy loam:7/											
80-OK-49-1	0-5	Ap	3.34	1.62	0.46	0.02	5.7	70.2	7.1	1.22	217.0
	5-20	B21t	5.32	3.59	0.43	0.03	14.5	57.5	6.4	0.63	205.0
	20-51	B22t	4.03	3.25	0.29	0.07	11.6	63.7	6.3	0.42	181.0
	51-65	B3	2.81	2.30	0.22	0.08	8.2	58.4	4.9	0.16	157.5

See footnote at end of table.

TABLE 19.--CHEMICAL ANALYSES OF SELECTED SOILS--Continued

Soil series and sample number	Depth	Horizon	Extractable bases (milliequivalents per 100 grams of soil) Ca	Mg	K	Na	Cation-exchange capacity	Base saturation	Reaction (1.1 soil-water)	Organic matter	Total phosphorus
	In							Pct	pH	Pct	P/M
Konawa fine sandy loam:8/											
80-OK-49-3	0-3	Ap	3.00	1.94	0.30	0.03	9.0	70.7	6.7	1.52	112.3
	3-14	B21t	5.15	5.27	0.36	0.06	20.1	69.9	5.9	1.08	111.5
	14-32	B22t	5.15	3.96	0.28	0.08	16.5	70.4	5.8	0.64	88.5
	32-71	B3	3.80	3.46	0.27	0.11	15.2	67.4	5.6	0.27	66.0
Loco silty clay loam:9/											
77-OK-49-1	0-6	A1	17.20	6.39	1.14	0.11	26.1	94.2	8.3	4.58	517.5
	6-17	B2	49.24	5.24	0.46	0.16	23.2	100.0	7.9	2.45	400.0
	17-36	Cr	49.22	3.13	0.45	0.30	17.1	100.0	7.7	1.23	492.5
Stephenville fine sandy loam:10/											
77-OK-49-2	0-4	A1	6.07	2.44	0.43	0.13	13.5	74.0	5.6	4.07	---
	4-16	B21t	5.70	3.82	0.46	0.13	14.8	78.3	6.1	1.35	---
	16-21	B22t	3.22	2.39	0.19	0.13	10.3	88.6	7.6	0.79	---
Teller loam:11/											
80-OK-49-6	0-4	Ap	4.66	1.90	0.01	1.49	10.3	66.4	6.0	2.04	327.5
	4-8	B1	6.39	2.51	0.71	0.01	14.0	78.0	6.8	1.12	205.0
	8-32	B21t	7.42	4.04	0.45	0.03	18.2	79.3	6.8	1.04	134.5
	32-45	B22t	5.93	5.36	0.38	0.09	18.2	70.7	6.2	0.77	88.5
	45-66	B3	5.48	4.74	0.36	0.11	15.6	71.8	6.4	0.30	66.0
Tussy clay:12/											
77-OK-49-5	0-4	A11	65-64	3.13	0.29	0.07	60.6	96.7	7.8	2.98	187.5
	4-8	A12	68.54	3.63	0.19	0.06	60.9	98.4	8.0	1.86	95.0
	8-16	B2	87.35	4.37	0.20	0.08	83.4	96.6	8.0	0.72	222.5
	16-32	B2	71.44	1.84	0.11	0.06	68.2	99.1	8.0	1.91	195.0
	32-60	C	79.17	6.16	0.15	0.39	77.0	96.6	8.2	3.04	260.0

1/Clarita clay:
2,000 feet south and 600 feet east of northwest corner of sec. 3, T. 2 N., R. 2 E. This pedon is a taxadjunct to the Clarita series because the A horizon has chroma of 2 with a depth of 12 inches in most pedons.

2/Garvin silty clay loam:
Typical pedon for the series.

3/Gracemont fine sandy loam:
Typical pedon for the series.

4/Konawa fine sandy loam:
1,350 feet south and 25 feet west of northeast corner of sec. 10, T. 4 N., R. 3 E

5/Konawa loamy sand:
1,325 feet south and 20 feet west of northwest corner of sec. 10, T. 4 N., R. 3 E.

6/Konawa fine sandy loam:
2,500 feet south and 750 feet east of northwest corner of sec. 32, T. 4 N., R. 1 E. This pedon is a taxadjunct to the Konawa series because the A horizon is slightly more clayey than allowed for the series.

7/Konawa fine sandy loam:
3,600 feet north and 950 feet east of southwest corner of sec. 34, T. 2 N., R. 3 W.

TABLE 19.--CHEMICAL ANALYSES OF SELECTED SOILS--Continued

8/Konawa fine sandy loam:
1,833 feet south and 100 feet east of northwest corner of sec. 32, T. 4 N., R. 1 E.

9/Loco silty clay loam:
Typical pedon for the series.

10/Stephenville fine sandy loam:
950 feet south and 300 feet east of the northwest corner of sec. 8, T. 3 N., R. 4 W. This pedon is a taxadjunct to the Stephenville series because the base saturation of the argillic horizon is 78 percent and the pH is more than 6.0.

11/Teller loam:
200 feet south and 3,500 feet west of northwest corner of sec. 28, T. 2 N., R. 3 W. This pedon is a taxadjunct to the Teller series because the A horizon is too thin for a mollic epipedon. The mollic colors are slightly too thin for a mollic epipedon, which is outside the range of the Teller series.

12/Tussy clay:
Typical pedon for the series. The B2 horizon was subdivided for sampling purposes.

TABLE 20.--ENGINEERING INDEX TEST DATA

[Dashes indicate data were not available. NP means nonplastic]

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution: Percentage passing sieve--				Grain-size distribution: Percentage smaller than--		Liquid limit	Plasticity index	Shrinkage		
	AASHTO	Unified	No. 4	No. 10	No. 40	No. 200	.005 mm	.002 mm			Limit	Linear	Ratio
									Pct	Pct	Pct	Pct	Pct
Gracemont fine sandy loam:1/ (SH-76OK-049-1)													
C1---7 to 29	A-4(00)	SM	100	100	100	048	006	005	---	NP	NP	0.0	NP
C2--29 to 47	A-4(06)	CL	100	100	099	078	025	021	28	10	14	0.0	1.86
A6--47 to 70	A-4(03)	CL-ML	100	100	098	078	020	017	26	06	16	0.0	1.78
Stephenville stony fine sandy loam:2/ (SH-76OK-049-2)													
B2t-4 to 16	A-4(0)	SM-SC	100	100	098	42	22	20	23	7	13	0.0	1.86

1/Gracemont fine sandy loam:
This pedon is a taxadjunct to the Gracemont series because the C2 horizon has a PI of 10 and a Unified Classification of CL.

2/Stephenville stony fine sandy loam:
950 feet south and 300 feet east of the northwest corner sec. 8, T. 3N., R. 4 W.

TABLE 21.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Amber	Coarse-silty, mixed, thermic Udic Ustochrepts
Asa	Fine-silty, mixed, thermic Fluventic Haplustolls
Asher	Fine-silty, mixed, thermic Fluventic Haplustolls
Bergstrom	Fine-silty, mixed, thermic Cumulic Haplustolls
Bethany	Fine, mixed, thermic Pachic Paleustolls
Burleson	Fine, montmorillonitic, thermic Udic Pellusterts
Chigley	Fine, mixed, thermic Udic Paleustalfs
*Clarita	Fine, montmorillonitic, thermic Udic Pellusterts
Dale	Fine-silty, mixed, thermic Pachic Haplustolls
Darnell	Loamy, siliceous, thermic, shallow Udic Ustochrepts
*Durant	Fine, montmorillonitic, thermic Vertic Argiustolls
Elandco	Fine-silty, mixed, thermic Cumulic Haplustolls
Gaddy	Sandy, mixed, thermic Typic Ustifluvents
Galey	Fine-loamy, mixed, thermic Ultic Paleustalfs
Garvin	Fine, montmorillonitic, thermic Vertic Haplustolls
Gracemont	Coarse-loamy, mixed (calcareous), thermic Aquic Udifluvents
Grainola	Fine, mixed, thermic Vertic Haplustalfs
Justin	Fine-loamy, mixed, thermic Udic Paleustolls
Keokuk	Coarse-silty, mixed, thermic Fluventic Haplustolls
Konawa	Fine-loamy, mixed, thermic Ultic Haplustalfs
Konsil	Fine-loamy, siliceous, thermic Ultic Paleustalfs
Lela	Fine, mixed, thermic Udic Chromusterts
Loco	Loamy, mixed, thermic, shallow Typic Haplustolls
*Lucien	Loamy, mixed, thermic, shallow Typic Haplustolls
McLain	Fine, mixed, thermic Pachic Argiustolls
Nash	Coarse-silty, mixed, thermic Udic Haplustolls
Newalla	Fine-loamy over clayey, siliceous, thermic Udic Haplustalfs
Norge	Fine-silty, mixed, thermic Udic Paleustolls
Port	Fine-silty, mixed, thermic Cumulic Haplustolls
Pulaski	Coarse-loamy, mixed, nonacid, thermic Typic Ustifluvents
Rayford	Loamy-skeletal, mixed, thermic Lithic Haplustolls
*Renfrow	Fine, mixed, thermic Udertic Paleustolls
Stephenville	Fine-loamy, siliceous, thermic Ultic Haplustalfs
*Teller	Fine-loamy, mixed, thermic Udic Argiustolls
Tussy	Fine, montmorillonitic, thermic Vertic Ustochrepts
Vanoss	Fine-silty, mixed, thermic Udic Argiustolls
Wilson	Fine, montmorillonitic, thermic Vertic Ochraqualfs
Yahola	Coarse-loamy, mixed (calcareous), thermic Typic Ustifluvents
*Zaneis	Fine-loamy, mixed, thermic Udic Argiustolls

*This soil is a taxadjunct to the series. See text for description of those characteristics of the soil that are outside the range of the series.

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