United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with
Kansas Agricultural
Experiment Station

Soil Survey of Wabaunsee County, Kansas

How To Use This Soil Survey

General Soil Map

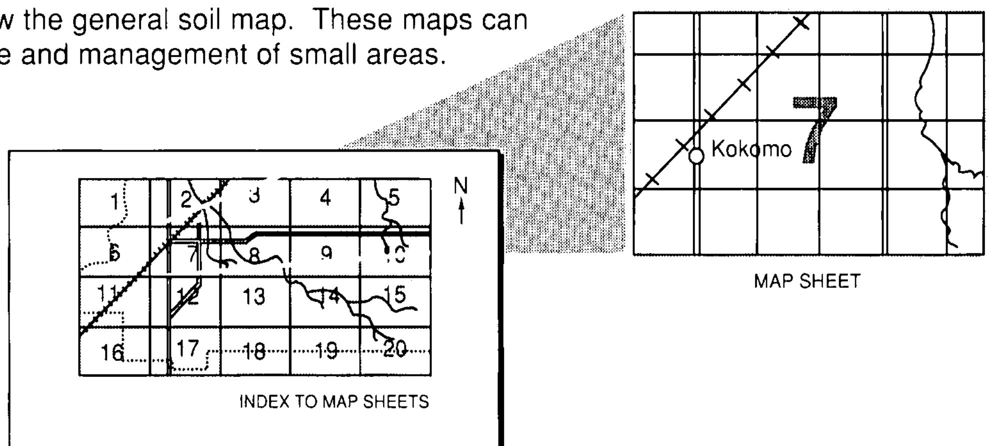
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

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

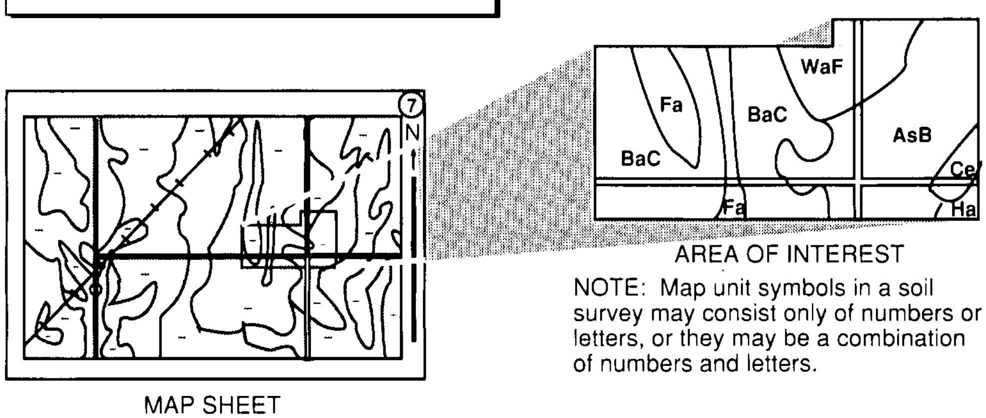
Detailed Soil Maps

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

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



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



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

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

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in the period 1985 to 1987. Soil names and descriptions were approved in 1987. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1986. This survey was made cooperatively by the Soil Conservation Service and the Kansas Agricultural Experiment Station. It is part of the technical assistance furnished to the Wabaunsee County Conservation District.

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

All programs and services of the Soil Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, marital status, or handicap.

Cover: Rangeland in good to excellent condition in an area of Florence-Labette complex, 3 to 15 percent slopes. Cherty limestone rock was used to build the wall.

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Issued May 1991

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Foreword

This soil survey contains information that can be used in land-planning programs in Wabaunsee County, Kansas. 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 over bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each 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.

James N. Habiger
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Soil Survey of Wabaunsee County, Kansas

By Steven P. Graber, Howard V. Campbell, and Bobby D. Tricks, Soil Conservation Service

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

General Nature of the County

WABAUNSEE COUNTY is in the east-central part of Kansas (fig. 1). It has a total area of 511,827 acres, or about 800 square miles. In 1980, it had a population of 6,879. In Alma, the county seat and largest town, the population was 958.

The majority of the county is in the Bluestem Hills major land resource area. The northeast corner, however, is in the Nebraska and Kansas Loess-Drift Hills, and the southeast corner is in the Cherokee Prairie. The Central Loess Plains major land resource area barely enters the county in an area near Alta Vista. Elevation ranges from about 900 feet above sea level in an area along the Kansas River near the Shawnee County line to about 1,600 feet at Gun Barrel Hill, south of Lake Wabaunsee.

Most of the county is drained by the Kansas River and Mill Creek. The east-central and southeastern parts, however, are drained by Mission and Dragoon Creeks. Municipal water-supply lakes are near Alma and Harveyville. Lake Wabaunsee is near the city of Eskridge.

Ranching, farming, and related services are the main sources of income in the county. About 65 percent of the county is range, 22 percent is cropland, 4 percent is woodland, 4 percent is pasture, and 5 percent is water areas or urban, industrial, or other land.

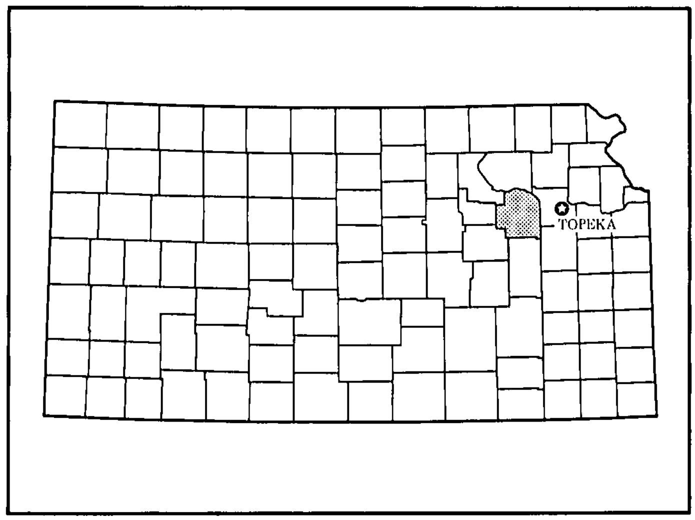

Figure 1.—Location of Wabaunsee County in Kansas.

Climate

Prepared by L. Dean Bark, climatologist, Kansas Agricultural Experiment Station.

The climate of Wabaunsee County is typical continental, as can be expected of a location in the interior of a large landmass in the middle latitudes. The climate is characterized by large daily and annual variations in temperature. Winters are cold because of frequent outbreaks of polar air. The cold temperatures prevail only from December to February. Warm summer temperatures prevail for about 6 months every year. They provide a long growing season for the crops grown in the county. Spring and fall are relatively short.

Wabaunsee County is in the path of a fairly dependable current of moisture-laden air from the Gulf of Mexico. Precipitation is heaviest in late spring and early summer. Much of it falls during late-evening or nighttime thunderstorms. Although the total precipitation generally is adequate for any crop, its distribution may cause problems in some years. Dry periods that last for several weeks are not uncommon during the growing season. A surplus of precipitation often results in muddy fields, which may delay planting and harvesting activities.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Eskridge in the period 1951 to 1976. 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 31.6 degrees F and the average daily minimum temperature is 21.3 degrees. The lowest temperature on record, which occurred at Eskridge on January 12, 1912, is -21 degrees. In summer, the average temperature is 76.3 degrees and the average daily maximum temperature is 88.4 degrees. The highest recorded temperature, which occurred on July 18, 1936, is 115 degrees.

The total annual precipitation is 35.39 inches. Of this, 25.20 inches, or 71 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 17.77 inches. The heaviest 1-day rainfall during the period of record was 6.83 inches at Eskridge on June 19, 1946. Severe windstorms and tornadoes accompany well developed thunderstorms, but they are infrequent and of local extent. Losses from hail are more severe, but they are not so great as the losses in counties to the west of this county.

The average seasonal snowfall is 21 inches. The highest recorded seasonal snowfall, which occurred during the winter of 1911-12, was 59.7 inches. On the average, 22 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The sun shines 75 percent of the time possible in summer and 61 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 12.6 miles per hour, in March.

Natural Resources

Soil is the most important natural resource in the county. It provides a growing medium for cash crops and for the grasses grazed by livestock. On about 50 percent of the acreage in the county, the soils are well suited or moderately well suited to cultivated crops. The steeper, shallow and moderately deep soils are used for good-quality native grasses.

Ground water wells are generally low yielding in the uplands. Parts of the county are served by rural water districts. Irrigation water of suitable quality and quantity is generally limited to the bottom land along the Kansas River and along Mill Creek.

Other natural resources include petroleum, limestone, sand, and gravel.

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 biological 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 a considerable degree of 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, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

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

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

Most inclusions 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 named and 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 soil 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 the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

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

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

The descriptions and names of the soils identified on the general soil map of this county do not fully agree with those of the soils identified on the maps of adjacent counties. Differences result from a better knowledge of soils, modifications in series concepts, a higher or lower intensity of mapping, and variations in the extent of the soils in the counties.

Soil Descriptions

1. Clime-Sogn-Martin Association

Deep to shallow, moderately sloping to steep, moderately well drained to somewhat excessively drained soils that have a clayey or silty subsoil or that are silty throughout; on uplands

This association is on ridgetops, side slopes, and foot slopes that are dissected by intermittent drainageways and creeks. Slopes range from 3 to 40 percent.

This association makes up about 34 percent of the county. It is about 35 percent Clime soils, 29 percent Sogn soils, 24 percent Martin soils, and 12 percent minor soils (fig. 2).

The moderately sloping to steep, moderately deep, well drained Clime soils formed in material weathered from calcareous, clayey shale on side slopes. Typically, the surface layer is black, calcareous silty clay loam about 6 inches thick. The subsurface layer also is black, calcareous silty clay loam. It is about 7 inches thick. The subsoil is about 17 inches thick. It is dark grayish brown and calcareous. The upper part is very firm silty clay, and the lower part is firm silty clay loam. The substratum is dark grayish brown, calcareous silty clay loam about 7 inches thick. Calcareous, clayey shale bedrock is at a depth of about 37 inches.

The moderately sloping to moderately steep, shallow, somewhat excessively drained Sogn soils formed in material weathered from limestone on ridgetops and side slopes. Typically, the surface layer is very dark gray silty clay loam about 6 inches thick. The subsurface layer is very dark brown silty clay loam about 7 inches thick. The next layer is very dark grayish brown, firm, channery silty clay loam about 4 inches thick. Limestone bedrock is at a depth of about 17 inches.

The moderately sloping, deep, moderately well drained Martin soils formed in material weathered from clayey shale on side slopes and foot slopes. Typically, the surface soil is black silty clay loam about 14 inches thick. The subsoil to a depth of about 60 inches is mottled, very firm silty clay. The upper part is very dark grayish brown, and the lower part is dark grayish brown.

Of minor extent in this association are the Irwin, Ivan, and Labette soils. The deep, moderately well drained Irwin soils are on ridgetops and the upper side slopes. The deep, well drained Ivan soils are on flood plains. The moderately deep, well drained Labette soils are on ridgetops and side slopes.

About 70 percent of this association is used as range or native hayland. The remaining 30 percent, which is generally on ridgetops, foot slopes, and flood plains, is

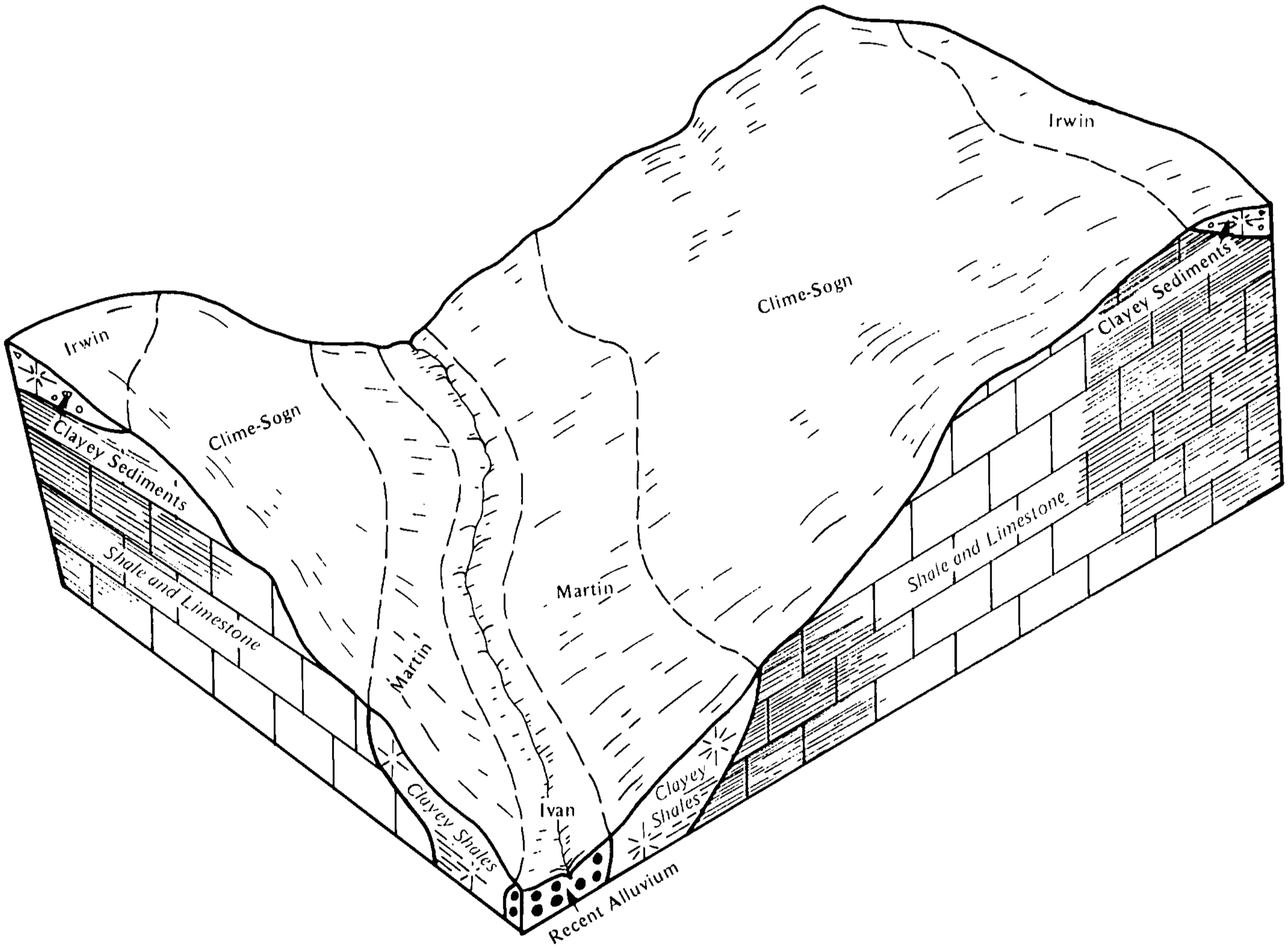

Figure 2.—Typical pattern of soils and parent material in the Clime-Sogn-Martin association.

used for cultivated crops, tame pasture, or legume hay. Maintaining the growth and vigor of desirable grasses and forbs and controlling brush are the main concerns in managing range. Controlling water erosion and maintaining tilth and fertility are the main concerns in managing the cultivated areas.

2. Florence-Irwin-Labette Association

Moderately deep and deep, gently sloping to strongly sloping, well drained and moderately well drained soils that have a clayey or a dominantly cherty and clayey subsoil; on uplands

This association is on narrow ridgetops, shoulder slopes, and side slopes that are dissected by narrow intermittent drainageways. Slopes range from 1 to 15 percent.

This association makes up about 23 percent of the county. It is about 26 percent Florence soils, 24 percent Irwin soils, 21 percent Labette soils, and 29 percent minor soils (fig. 3).

The moderately sloping and strongly sloping, deep, well drained Florence soils formed in material weathered from cherty limestone on shoulder slopes and side slopes. Typically, the surface soil is very dark grayish brown cherty silt loam about 14 inches thick. The subsoil is about 42 inches thick. In sequence downward, it is dark grayish brown, firm cherty silty clay loam; dark brown, very firm very cherty silty clay; dark reddish brown, extremely firm very cherty clay; and

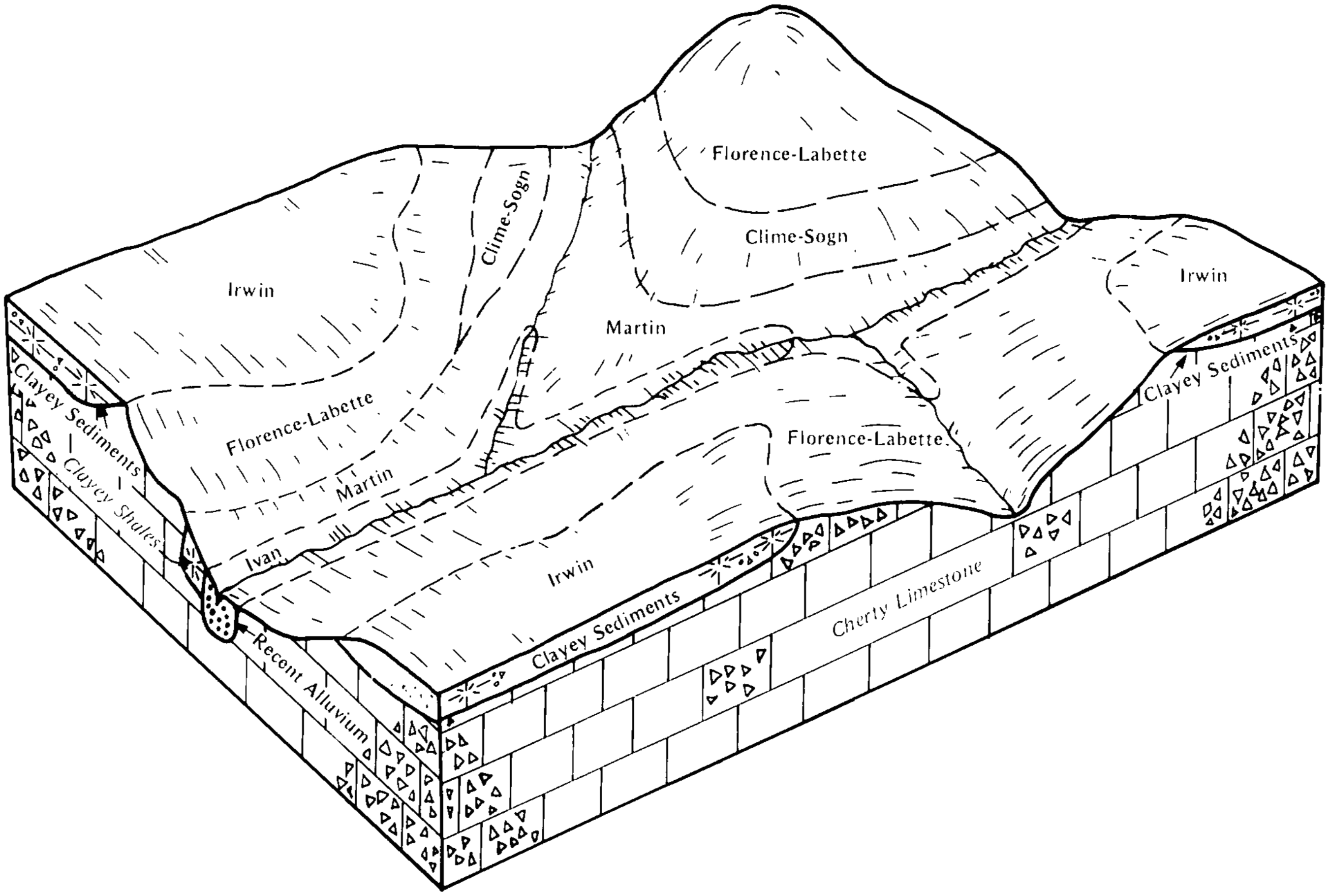

Figure 3.—Typical pattern of soils and parent material in the Florence-Irwin-Labette association.

reddish brown and red, extremely firm cherty clay. Cherty limestone bedrock is at a depth of about 56 inches.

The gently sloping and moderately sloping, deep, moderately well drained Irwin soils formed in clayey sediments on side slopes and shoulder slopes. Typically, the surface soil is very dark brown silty clay loam about 12 inches thick. The subsoil is about 30 inches thick. It is mottled. The upper part is very dark grayish brown and very dark brown, very firm silty clay; the next part is very dark grayish brown and dark grayish brown, very firm clay; and the lower part is dark brown, very firm silty clay. The substratum to a depth of about 60 inches is dark reddish brown, mottled clay.

The gently sloping and moderately sloping, moderately deep, well drained Labette soils formed in material weathered from interbedded cherty limestone and clayey shale on narrow ridgetops and shoulder slopes. Typically, the surface layer is very dark brown silty clay loam about 8 inches thick. The subsoil is very firm silty clay about 29 inches thick. The upper part is very dark grayish brown, the next part is dark brown and brown and is mottled, and the lower part is dark reddish brown and mottled. Cherty limestone bedrock is at a depth of about 37 inches.

Of minor extent in this association are the Clime, Ivan, Martin, and Sogn soils. The moderately deep, calcareous Clime soils and the shallow Sogn soils are on the lower side slopes. The well drained Ivan soils are on flood plains. The moderately well drained, slowly permeable Martin soils are on foot slopes.

Almost all of this association is used as range. Some areas on foot slopes and flood plains are used for cultivated crops. Maintaining the growth and vigor of desirable grasses and forbs and controlling brush are the main concerns in managing range.

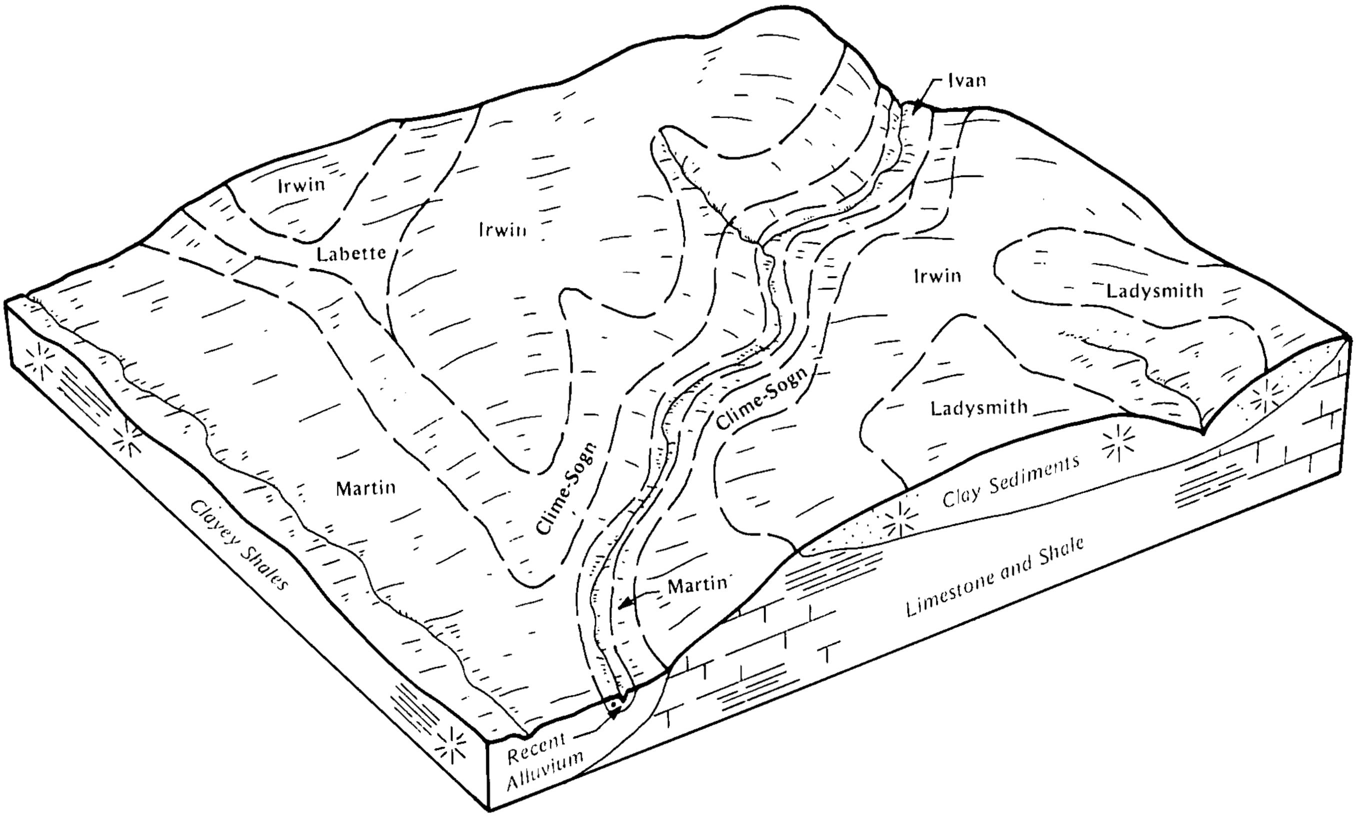

Figure 4.—Typical pattern of soils and parent material in the Irwin-Martin-Ladysmith association.

3. Irwin-Martin-Ladysmith Association

Deep, nearly level to moderately sloping, moderately well drained and somewhat poorly drained soils that have a clayey subsoil; on uplands

This association is on side slopes, foot slopes, shoulder slopes, and broad ridgetops. Intermittent drainageways are common. Slopes range from 0 to 7 percent.

This association makes up about 18 percent of the county. It is about 36 percent Irwin soils, 22 percent Martin soils, 13 percent Ladysmith soils, and 29 percent minor soils (fig. 4).

The gently sloping and moderately sloping, moderately well drained Irwin soils formed in clayey sediments on side slopes and shoulder slopes. Typically, the surface soil is very dark brown silty clay loam about 12 inches thick. The subsoil is about 30 inches thick. It is mottled. The upper part is very dark grayish brown and very dark brown, very firm silty clay; the next part is very dark grayish brown and dark grayish brown, very firm clay; and the lower part is dark brown, very firm silty clay. The substratum to a depth of about 60 inches is dark reddish brown, mottled clay.

The moderately sloping, moderately well drained Martin soils formed in material weathered from clayey shale on side slopes and foot slopes. Typically, the surface soil is black silty clay loam about 14 inches thick. The subsoil to a depth of about 60 inches is mottled, very firm silty clay. The upper part is very dark grayish brown, and the lower part is dark grayish brown.

The nearly level, somewhat poorly drained Ladysmith soils formed in clayey sediments or old alluvium on broad ridgetops. Typically, the surface layer is black silty clay loam about 8 inches thick. The subsoil is about 42 inches thick. The upper part is very dark brown, very firm silty clay; the next part is very dark grayish brown, dark grayish brown, and dark gray, mottled, very firm clay; and the lower part is grayish brown, mottled, very firm silty clay. The substratum to a depth of about 60 inches is light brownish gray, mottled silty clay.

Of minor extent in this association are the Clime, Labette, Sogn, and Ivan soils. The moderately deep, well drained Clime soils and the shallow Sogn soils are on side slopes. The moderately deep, well drained Labette soils are on narrow ridgetops and the upper shoulder slopes. The deep, well drained Ivan soils are on flood plains.

About 80 percent of this association is used for cultivated crops. The rest is used as hayland or range. Wheat, grain sorghum, and soybeans are the chief crops. Controlling water erosion and maintaining tilth and fertility are the main concerns in managing the cultivated areas. Maintaining the growth and vigor of desirable grasses and forbs is the main concern in managing range.

4. Eudora-Haynie-Wabash Association

Deep, nearly level, well drained and very poorly drained soils that have a clayey subsoil, have silty lower layers, or are loamy throughout; on stream terraces and flood plains

This association is on flood plains and stream terraces along the Kansas River. The Eudora soils are subject to rare flooding. The Haynie and Wabash soils are occasionally flooded. Slopes range from 0 to 2 percent.

This association makes up about 4 percent of the county. It is about 41 percent Eudora soils, 13 percent Haynie soils, 13 percent Wabash soils, and 33 percent minor soils.

The well drained Eudora soils formed in silty alluvium on stream terraces. Typically, the surface layer is very dark grayish brown silt loam about 10 inches thick. The subsurface layer is very dark brown silt loam about 5 inches thick. The next layer is dark grayish brown and brown, friable silt loam about 3 inches thick. The upper part of the substratum is brown silt loam. The lower part to a depth of about 60 inches is pale brown, mottled, calcareous silt loam.

The well drained Haynie soils formed in calcareous, silty alluvium on flood plains. Typically, the surface layer is very dark grayish brown very fine sandy loam about 9 inches thick. The substratum is calcareous silt loam. The upper part is dark brown, the next part is grayish brown, and the lower part to a depth of about 60 inches is brown and stratified.

The very poorly drained Wabash soils formed in clayey alluvium on flood plains. Typically, the surface layer is black silty clay about 6 inches thick. The subsurface layer is black, mottled silty clay about 16 inches thick. The subsoil to a depth of more than 60 inches is extremely firm, mottled clay. The upper part is very dark gray, and the lower part is dark gray.

Of minor extent in this association are the Kimo, Paxico, Reading, and Sarpy soils. The somewhat poorly drained Kimo soils are in slight depressions on low stream terraces. The somewhat poorly drained Paxico soils are on flood plains near the major river channels. The moderately well drained Reading soils are on high stream terraces. The sandy Sarpy soils are on flood plains along the major rivers.

Most of this association is used for cultivated crops. The rest is used as hayland or woodland. Corn, grain sorghum, wheat, alfalfa, and soybeans are the chief crops. Maintaining tilth and fertility is the main concern in managing the cultivated areas.

5. Ivan-Reading-Chase Association

Deep, nearly level, somewhat poorly drained and well drained soils that have a silty or clayey subsoil or have silty lower layers; on stream terraces and flood plains

This association is on flood plains and stream terraces along creeks and streams. The Chase and Reading soils are subject to rare flooding. The Ivan soils are occasionally or frequently flooded. Slopes range from 0 to 2 percent.

This association makes up about 6 percent of the county. It is about 50 percent Ivan soils, 22 percent Reading soils, 16 percent Chase soils, and 12 percent minor soils.

The well drained Ivan soils formed in calcareous, silty alluvium on flood plains. Typically, the surface layer is very dark grayish brown, calcareous silt loam about 8 inches thick. The subsurface layer is very dark gray, calcareous silt loam about 13 inches thick. The next layer is very dark grayish brown, friable, calcareous silt loam about 15 inches thick. The substratum to a depth of about 60 inches is dark grayish brown, calcareous silt loam.

The well drained Reading soils formed in silty alluvium on stream terraces. Typically, the surface layer is very dark gray silty clay loam about 6 inches thick. The subsurface layer also is very dark gray silty clay loam. It is about 7 inches thick. The subsoil is firm silty clay loam about 32 inches thick. The upper part is very dark grayish brown, and the lower part is dark brown and mottled. The substratum to a depth of about 60 inches is dark brown, mottled silty clay loam.

The somewhat poorly drained Chase soils formed in clayey alluvium on stream terraces. Typically, the surface soil is very dark gray silty clay loam about 12 inches thick. The subsoil extends to a depth of about 60 inches. It is mottled. The upper part is very firm, very dark gray silty clay; the next part is extremely firm, dark

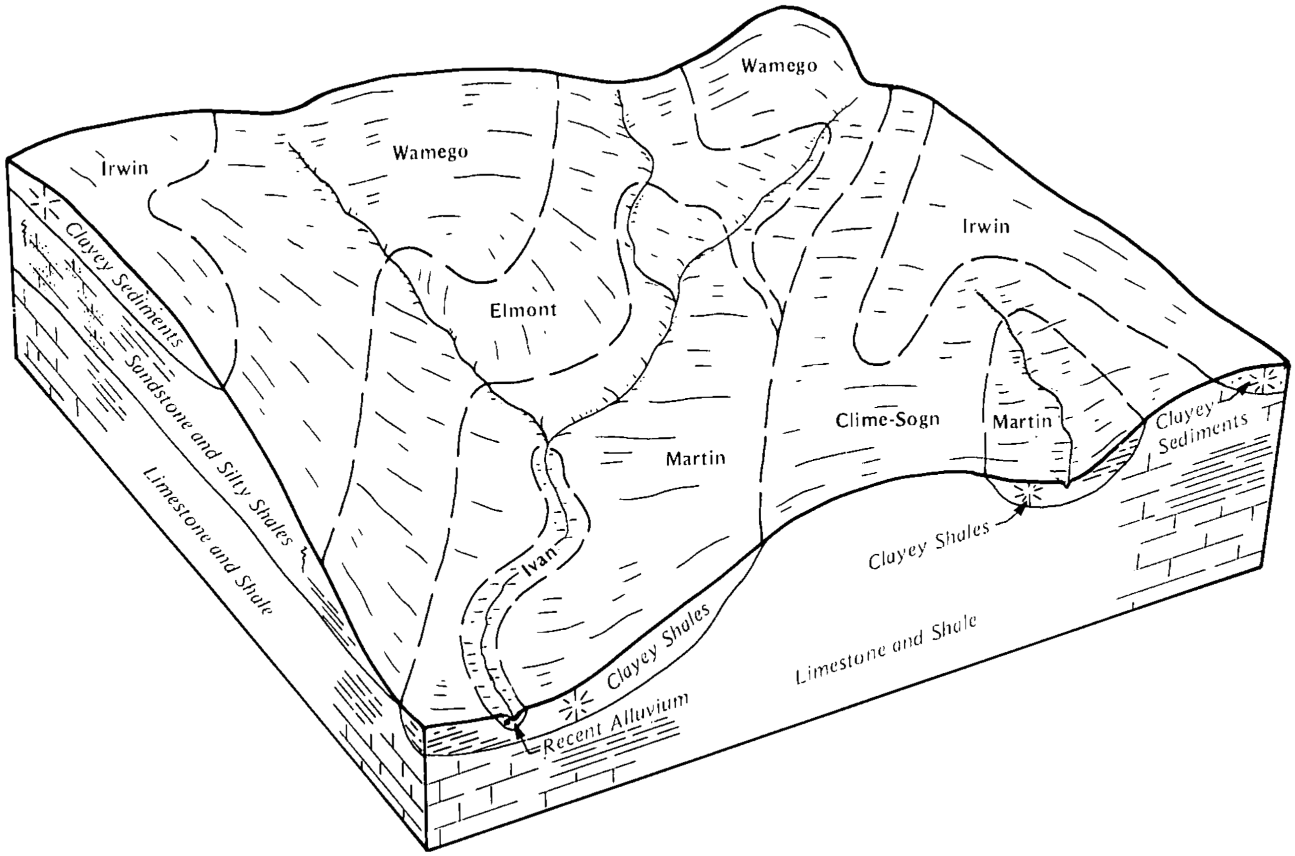

Figure 5.—Typical pattern of soils and parent material in the Martin-Wamego-Elmont association.

gray and dark grayish brown clay; and the lower part is very firm, grayish brown silty clay.

Of minor extent in this association are the Martin and Wabash soils. The moderately well drained Martin soils are on foot slopes and side slopes in the uplands. The very poorly drained Wabash soils are on stream terraces.

This association is used almost entirely for cultivated crops or for hay. A few areas are used as woodland. Corn, grain sorghum, soybeans, alfalfa, and small grain are the chief crops. Controlling flooding and maintaining fertility and tilth are the main concerns in managing the cultivated areas.

6. Martin-Wamego-Elmont Association

Deep and moderately deep, moderately sloping and strongly sloping, well drained and moderately well drained soils that have a clayey or silty subsoil; on uplands

This association is on side slopes, foot slopes, and narrow ridgetops dissected by intermittent drainageways. Slopes range from 3 to 15 percent.

This association makes up about 7 percent of the county. It is about 31 percent Martin soils, 30 percent Wamego soils, 12 percent Elmont soils, and 27 percent minor soils (fig. 5).

The moderately sloping, deep, moderately well drained Martin soils formed in material weathered from clayey shale on side slopes and foot slopes. Typically, the surface soil is black silty clay loam about 14 inches thick. The subsoil to a depth of about 60 inches is mottled, very firm silty clay. The upper part is very dark grayish brown, and the lower part is dark grayish brown.

The moderately sloping and strongly sloping, moderately deep, well drained Wamego soils formed in material weathered from interbedded sandstone and silty shale on ridgetops and side slopes. Typically, the surface layer is very dark gray silty clay loam about 7 inches thick. The subsurface layer also is very dark grayish brown silty clay loam. It is about 4 inches thick. The subsoil is mottled, firm silty clay loam about 14

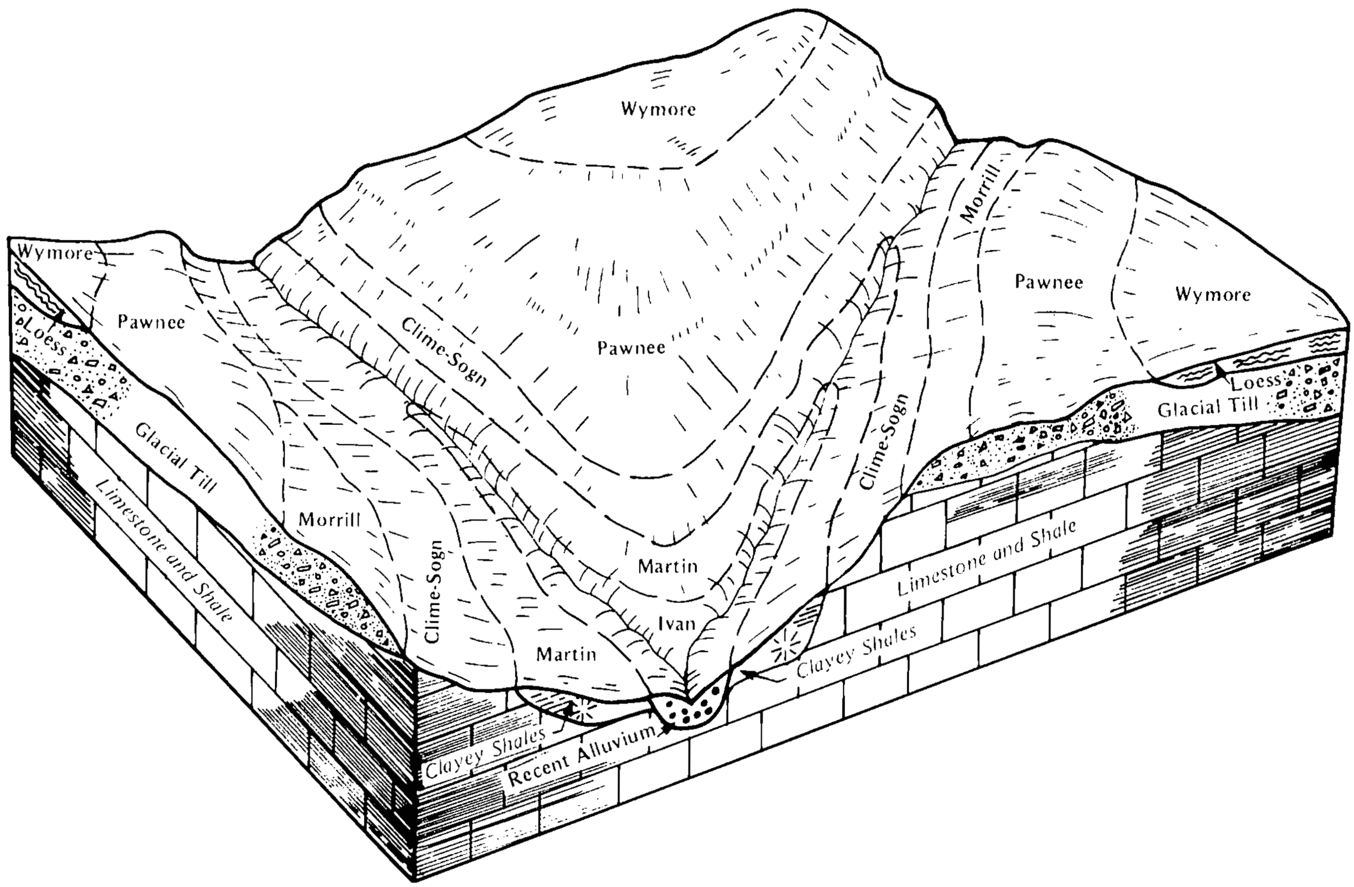

Figure 6.—Typical pattern of soils and parent material in the Pawnee-Martin-Wymore association.

inches thick. The upper part is brown and dark brown, and the lower part is dark grayish brown and brown. Shale bedrock is at a depth of about 25 inches.

The moderately sloping, deep, well drained Elmont soils formed in material weathered from interbedded sandstone and noncalcareous, micaceous, silty shale on side slopes and foot slopes. Typically, the surface layer is black silt loam about 12 inches thick. The subsurface layer is black and dark brown silt loam about 7 inches thick. The subsoil is firm silty clay loam about 38 inches thick. The upper part is dark brown, the next part is dark yellowish brown and mottled, and the lower part is brownish yellow and pale brown and is mottled. Silty shale bedrock is at a depth of about 57 inches.

Of minor extent in this association are the Clime, Irwin, Ivan, and Sogn soils. The moderately deep, calcareous Clime soils are on the upper side slopes. The deep, moderately well drained Irwin soils are on ridgetops. The deep, well drained, calcareous Ivan soils are on flood plains along narrow drainageways. The shallow, somewhat excessively drained Sogn soils are on the breaks of ridgetops and the upper side slopes.

About two-thirds of this association is used as range. The rest is used mainly for cultivated crops. Some areas are used for hay and pasture. Controlling erosion and maintaining tilth and fertility are the main concerns in managing the cultivated areas. Maintaining the growth and vigor of desirable grasses and forbs is the main concern in managing range.

7. Pawnee-Martin-Wymore Association

Deep, gently sloping and moderately sloping, moderately well drained soils that have a clayey subsoil; on uplands

This association is on side slopes, foot slopes, and ridgetops. Intermittent drainageways are common. Slopes range from 1 to 7 percent.

This association makes up about 8 percent of the county. It is about 44 percent Pawnee soils, 28 percent

Martin soils, 10 percent Wymore soils, and 18 percent minor soils (fig. 6).

The gently sloping and moderately sloping Pawnee soils formed in glacial till on ridgetops and side slopes. Typically, the surface layer is very dark brown clay loam about 11 inches thick. The subsurface layer is very dark grayish brown, mottled clay loam about 6 inches thick. The subsoil extends to a depth of about 60 inches. It is mottled and very firm. The upper part is dark grayish brown clay; the next part is dark brown, brown, and pale brown clay; and the lower part is pale brown and light gray clay loam.

The moderately sloping Martin soils formed in material weathered from clayey shale on side slopes and foot slopes. Typically, the surface soil is black silty clay loam about 14 inches thick. The subsoil to a depth of about 60 inches is mottled, very firm silty clay. The upper part is very dark grayish brown, and the lower part is dark grayish brown.

The gently sloping and moderately sloping Wymore soils formed in loess on ridgetops and the upper side slopes. Typically, the surface layer is very dark brown silty clay loam about 8 inches thick. The subsoil is very firm, mottled silty clay about 32 inches thick. The upper part is very dark grayish brown, the next part is dark brown and brown, and the lower part is grayish brown. The substratum to a depth of about 60 inches is mottled silty clay loam. The upper part is grayish brown and light brownish gray, and the lower part is grayish brown.

Of minor extent in this association are the Clime, Ivan, Morrill, and Sogn soils. The moderately deep, calcareous Clime soils are on side slopes. The well drained, calcareous Ivan soils are on flood plains along narrow drainageways. The well drained Morrill soils are on ridgetops and side slopes. The shallow, somewhat excessively drained Sogn soils are on the breaks of ridgetops and side slopes.

About 60 percent of this association is used as range or native hayland. The rest is used for cultivated crops, pasture, or legume hay. Maintaining the growth and vigor of desirable grasses and forbs and controlling brush are the main concerns in managing range. Controlling water erosion and maintaining tilth and fertility are the main concerns in managing the cultivated areas.

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 substratum, 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 substratum. 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, Pawnee clay loam, 1 to 3 percent slopes, is a phase of the Pawnee series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, 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. Florence-Labette complex, 3 to 15 percent slopes, is an example.

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

The descriptions and names of the soils identified on the detailed soil maps of this county do not fully agree with those of the soils identified on the maps of adjacent counties. Differences result from a better knowledge of soils, modifications in series concepts, a higher or lower intensity of mapping, and variations in the extent of the soils in the counties.

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

Ce—Chase silty clay loam. This deep, nearly level, somewhat poorly drained soil is on stream terraces. It is subject to rare flooding. Individual areas are irregular in shape and range from 30 to 1,200 acres in size.

Typically, the surface soil is very dark gray silty clay loam about 12 inches thick. The subsoil extends to a depth of about 60 inches. It is mottled. The upper part is very firm, very dark gray silty clay; the next part is extremely firm, dark gray and dark grayish brown clay; and the lower part is very firm, grayish brown silty clay. In places the dark colors extend to a depth of less than 36 inches.

Included with this soil in mapping are small areas of Ivan, Reading, and Wabash soils. The calcareous Ivan soils are silty. They are adjacent to the stream channels. The well drained Reading soils are on the slightly higher stream terraces. They are less clayey than the Chase soil. The very poorly drained Wabash soils are in old stream channels next to the uplands. They are more clayey than the Chase soil. Included soils make up about 10 percent of the map unit.

Permeability is slow in the Chase soil. Runoff also is slow. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is friable. The shrink-swell potential is high in the subsoil. A perched seasonal high water table is at a depth of about 2 to 4 feet in late winter and in spring.

Nearly all of the acreage is used for cultivated crops. This soil is well suited to wheat, grain sorghum, soybeans, and alfalfa. In years of above average rainfall, crop yields may be reduced by standing water. Tillage is sometimes delayed because of wetness. If the soil is tilled when it is too wet, surface compaction is a problem. It can be minimized, however, by timely tillage. The clayey subsoil restricts the movement of air and water and root penetration and slowly releases water to plants. A system of conservation tillage that reduces the number of tillage operations and leaves all or part of the crop residue on the surface improves tilth and fertility, minimizes crusting, and increases the rate of water infiltration.

This soil is generally unsuited to dwellings because of the flooding, the wetness, and the shrink-swell potential. Onsite inspection and knowledge of the history of flooding in a given area are needed when building sites are selected. Overcoming the hazard of flooding is difficult without major flood-control measures.

This soil is unsuited to septic tank absorption fields because of the wetness and the slow permeability. It is well suited to sewage lagoons. In the spring, the wetness can be a problem. Interceptor tiles around the lagoon site can lessen the risk of contamination.

The land capability classification is IIw, and the range site is Loamy Lowland.

Cm—Clime silty clay loam, 3 to 7 percent slopes. This moderately deep, moderately sloping, well drained soil is on ridgetops and side slopes. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is very dark gray silty clay loam about 5 inches thick. The subsurface layer is black, calcareous silty clay about 7 inches thick. The subsoil is dark brown and grayish brown, firm, calcareous silty clay about 6 inches thick. The substratum is grayish brown, calcareous silty clay about 14 inches thick. Calcareous, clayey shale bedrock is at a depth of about 32 inches. In some places the soil is noncalcareous throughout. In other places the subsoil is redder.

Included with this soil in mapping are small areas of Martin, Sogn, and Wamego soils. The deep Martin soils are on the lower side slopes. The shallow Sogn soils are in positions on the landscape similar to those of the Clime soil. The noncalcareous Wamego soils are on side slopes below the Clime soil. Included soils make up 15 percent of the map unit.

Permeability is slow in the Clime soil. Runoff is medium. Available water capacity is low. Organic matter content is moderate, and natural fertility is medium. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate in the subsoil. Root development is restricted by the bedrock at a depth of about 32 inches.

About half of the areas are used as cropland. Range, abandoned cropland, and areas reseeded to grass make up the rest of the acreage. This soil is poorly suited to wheat, soybeans, and grain sorghum. Water erosion is a hazard and droughtiness and the restricted rooting depth are limitations if cultivated crops are grown. Reducing the number of tillage operations, farming on the contour, establishing grassed waterways, terracing, and applying a system of conservation tillage that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve tilth and fertility, minimize crusting, and increase the rate of water infiltration.

This soil is better suited to tame or native grasses for grazing or haying than to cultivated crops. The native vegetation is dominantly little bluestem, big bluestem, and sideoats grama. In overgrazed areas these grasses are replaced by less productive grasses and by weeds. Proper stocking rates, rotation grazing, and timely deferment of grazing help to keep the range in the best condition. Range seeding is needed to restore the productivity of abandoned cropland. Early mowing of hay allows the plants to recover and store food before the first frost. Applications of fertilizer increase forage production in the areas of tame grasses.

This soil is moderately well suited to dwellings. The shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling.

This soil is generally unsuited to septic tank absorption fields because of the depth to bedrock and the slow permeability. It is generally unsuited to sewage lagoons because of the depth to bedrock.

The land capability classification is IVe, and the range site is Limy Upland.

Cr—Clime silty clay loam, 20 to 40 percent slopes, stony. This moderately deep, steep, well drained soil is on breaks and side slopes. Scattered limestone rocks are on the surface. The rocks are irregular in shape and range from 1 to 3 feet in diameter. They cover less than 1 percent of the surface and are 3 to 40 feet apart. Individual areas are narrow and follow the bluffs along the larger creeks. They range from 50 to 1,200 acres in size.

Typically, the surface layer is black, calcareous silty clay loam about 9 inches thick. The subsoil is about 18 inches thick. The upper part is very dark gray, calcareous, firm silty clay loam, and the lower part is dark grayish brown, calcareous, very firm silty clay. The substratum is olive gray, calcareous silty clay loam about 6 inches thick. Calcareous, clayey shale bedrock is at a depth of about 33 inches. In places the depth to shale is less than 20 inches.

Included with this soil in mapping are small areas of Martin, Sogn, and Tuttle soils and rock outcrops. The deep Martin soils are on foot slopes. The shallow Sogn soils are in the less sloping areas above the rock outcrops. The deep Tuttle soils are in positions on the landscape similar to those of the Clime soil. The rock outcrops occur as narrow bands on the contour of the slopes. Included areas make up about 25 percent of the map unit.

Permeability is slow in the Clime soil. Runoff is rapid. Available water capacity is low. Organic matter content is moderate, and natural fertility is medium. The shrink-swell potential is moderate in the subsoil. Root development is restricted by the bedrock at a depth of about 33 inches.

Nearly all of the acreage is used as range or supports native vegetation. Because of a severe hazard of erosion, the slope, and the many stones on the surface, this soil is unsuited to cultivated crops. It is better suited to range. The native vegetation is dominantly big bluestem, little bluestem, indiangrass, and sideoats grama. Trees and brush have invaded in some areas. As a result, brush control is needed to increase forage production. Controlled burning in late spring helps to remove the woody plants. Properly applied chemical sprays and selective cutting also help to remove these plants. Obtaining a proper distribution of grazing is a major management concern. Many areas are grazed infrequently because of the slope and the stones on the surface. Properly located fences and well distributed water, salt, and minerals improve the distribution of grazing.

This soil is generally unsuited to building site development because of the slope.

The land capability classification is VIIe, and the range site is Limy Upland.

Cs—Clime-Sogn silty clay loams, 5 to 20 percent slopes. These moderately sloping to moderately steep soils are on ridgetops and side slopes that are generally dissected by many drainageways. The moderately deep, well drained Clime soil is on the side slopes. The shallow, somewhat excessively drained Sogn soil is on the ridgetops. Individual areas are irregular in shape and range from 10 to 50,000 acres in size. They are about 60 percent Clime soil and 20 percent Sogn soil. The two soils occur as alternating bands that are so narrow that mapping them separately is impractical.

Typically, the Clime soil has a surface layer of black, calcareous silty clay loam about 6 inches thick. The subsurface layer also is black, calcareous silty clay loam. It is about 7 inches thick. The subsoil is about 17 inches thick. It is dark grayish brown and calcareous. The upper part is very firm silty clay, and the lower part is firm silty clay loam. The substratum is dark grayish brown, calcareous silty clay loam about 7 inches thick. Calcareous, clayey shale bedrock is at a depth of about 37 inches. In some places the soil is noncalcareous throughout and has a redder subsoil. In other places it has common chert fragments throughout.

Typically, the Sogn soil has a surface layer of very dark gray silty clay loam about 6 inches thick. The subsurface layer is very dark brown silty clay loam about 7 inches thick. The next layer is very dark grayish brown, firm channery silty clay loam about 4 inches thick. Limestone bedrock is at a depth of about 17 inches. In places the soil is calcareous throughout.

Included with these soils in mapping are small areas of Ivan, Labette, and Martin soils and limestone outcrops. The deep Ivan soils are on flood plains along small drainageways. The moderately deep Labette soils have a subsoil that is redder than that of the Clime and Sogn soils. They are on shoulder slopes and narrow ridgetops. The deep Martin soils are on foot slopes. The limestone outcrops are on breaks, in the steeper areas, and on side slopes, generally below the Sogn soil. Included areas make up about 20 percent of the map unit.

Permeability is slow in the Clime soil and moderate in the Sogn soil. Available water capacity is low in the Clime soil and very low in the Sogn soil. Runoff is rapid on both soils. Organic matter content is moderate. Natural fertility is medium in the Clime soil and low in the Sogn soil. The shrink-swell potential is moderate in the subsoil of the Clime soil and moderate throughout the Sogn soil. Root development is restricted by the bedrock at a depth of about 37 inches in the Clime soil and at a depth of about 17 inches in the Sogn soil.

Nearly all of the acreage is used as range. Some small areas are wooded. Because of a severe hazard of erosion on both soils and the shallowness to limestone in the Sogn soil, this map unit is unsuited to cultivated crops. It is better suited to range. The native vegetation is dominantly big bluestem, little bluestem, and sideoats grama. Sideoats grama is more common on the shallow Sogn soil than on the Clime soil. Overgrazing depletes the plant cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and weeds, such as blue grama, annual grasses, western ragweed, and aromatic sumac. Proper stocking rates, rotation grazing, and timely deferment of grazing help to keep the range in good condition. Trees and brush have invaded in some areas. As a result, brush control is needed to increase forage production. Controlled burning in late spring helps to remove the woody plants. Properly applied chemical sprays and selective cutting also help to remove these plants.

The Clime soil is only moderately well suited to dwellings because of the slope and the shrink-swell potential. Properly designing and reinforcing foundations and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling. The less sloping areas will require less land shaping.

Because of the depth to bedrock, the slow permeability, and the slope, the Clime soil is generally unsuited to septic tank absorption fields and sewage lagoons.

The Sogn soil is generally unsuited to building site development because of the shallowness to bedrock and the slope.

The land capability classification is VIe. The range site assigned to the Clime soil is Limy Upland, and the one assigned to the Sogn soil is Shallow Limy.

Eo—Elmont silt loam, 3 to 7 percent slopes. This deep, moderately sloping, well drained soil is on side slopes and foot slopes. Individual areas are irregular in shape and range from 20 to 300 acres in size.

Typically, the surface layer is black silt loam about 12 inches thick. The subsurface layer is black and dark brown silt loam about 7 inches thick. The subsoil is firm silty clay loam about 38 inches thick. The upper part is dark brown, the next part is dark yellowish brown and mottled, and the lower part is brownish yellow and pale brown and is mottled. Silty shale bedrock is at a depth of about 57 inches. In some places the depth to unweathered shale is less than 40 inches, and in other places it is more than 60 inches. In some areas the soil is less clayey.

Included with this soil in mapping are small areas of Clime, Martin, and Wamego soils and sandstone and shale outcrops. The calcareous Clime soils are on side slopes above the Elmont soil. The moderately well drained Martin soils are on side slopes above and below the Elmont soil. The moderately deep Wamego soils are on ridgetops and the upper side slopes above the Elmont soil. The sandstone and shale outcrops are in scattered areas throughout the map unit. Included areas make up about 20 percent of the map unit.

Permeability is moderately slow in the Elmont soil. Runoff is medium. Available water capacity is high. Organic matter content is moderate, and natural fertility is medium. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate in the subsoil.

Most areas are used for cultivated crops. The rest are used for range or tame grass pasture. This soil is moderately well suited to wheat, soybeans, grain sorghum, and alfalfa. Water erosion is a hazard if cultivated crops are grown. It can be controlled by reducing the number of tillage operations, farming on the contour, establishing grassed waterways, terracing, and applying a system of conservation tillage that leaves all or part of the crop residue on the surface. Returning crop residue to the soil and adding other organic material improve tilth and fertility, minimize crusting, and increase the rate of water infiltration.

This soil is suited to range. The native vegetation is dominantly big bluestem, little bluestem, switchgrass, and indiangrass. In overgrazed areas the less productive grasses, such as tall dropseed, make up a larger percentage of the plant community. Proper stocking rates, rotation grazing, and timely deferment of grazing and haying help to keep the range in good condition. Woody plants invade in some areas. They can be removed by timely burning. Early mowing of hay allows the desirable plants to recover and store food before the first frost. Applications of fertilizer increase forage production in the areas of tame grasses.

This soil is only moderately well suited to dwellings because of the shrink-swell potential. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling.

This soil is poorly suited to septic tank absorption fields because of the moderately slow permeability. Enlarging the absorption field can help to overcome this limitation. The soil is only moderately well suited to sewage lagoons because of the depth to bedrock and the slope. Some land shaping is needed.

The land capability classification is IIIe, and the range site is Loamy Upland.

Eu—Eudora silt loam. This deep, nearly level, well drained soil is on low stream terraces along the Kansas River. It is subject to rare flooding. Individual areas are irregular in shape and range from 50 to 800 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 10 inches thick. The subsurface layer is very dark brown silt loam about 5 inches thick. The next layer is dark grayish brown and brown, friable silt loam about 3 inches thick. The upper part of the substratum is brown silt loam. The lower part to a depth of about 60 inches is pale brown, mottled, calcareous silt loam. In some places the soil is darker colored below a depth of 24 inches. In other places the surface layer is calcareous and is lighter colored.

Included with this soil in mapping are small areas of Kimo soils in the lower positions on the landscape. These soils are more clayey than the Eudora soil. They make up about 5 percent of the map unit.

Permeability is moderate in the Eudora soil. Runoff is slow. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is low throughout the profile.

Nearly all of the acreage is used for cultivated crops. This soil is well suited to corn, grain sorghum, soybeans, wheat, and alfalfa. The main management concerns are conserving moisture and maintaining fertility. Minimizing tillage and leaving crop residue on the surface conserve moisture and help to maintain fertility. Crop rotations help to control weeds, plant diseases, and insect carry-over.

Corn, grain sorghum, and soybeans are the main irrigated crops. The main concerns in managing irrigated areas are using water efficiently and maintaining soil fertility. Leaving crop residue on the surface helps to maintain tilth and fertility. Controlling the rate of water application conserves irrigation water.

This soil is generally unsuited to dwellings because of the flooding. Onsite inspection and knowledge of the history of flooding in a given area are needed when building sites are selected. Overcoming this hazard is difficult without major flood-control measures.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The flooding is a hazard on sites for septic tank absorption fields. Levees and dikes help to control floodwater. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the lagoon.

The land capability classification is I, and the range site is Loamy Lowland.

Ex—Eudora-Kimo complex. These deep, nearly level soils are on terraces along the Kansas River. They are subject to rare flooding. The well drained Eudora soil is on the higher parts of the landscape, and the somewhat poorly drained Kimo soil is on the lower parts, generally in small depressions. Individual areas are irregular in shape and range from 20 to 700 acres in size. They are about 70 percent Eudora soil and 25 percent Kimo soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the Eudora soil has a surface layer of very dark grayish brown silt loam about 7 inches thick. The subsurface layer is very dark brown silt loam about 10 inches thick. The next layer is very dark grayish brown and dark grayish brown, friable silt loam about 5 inches thick. The upper part of the substratum is brown, calcareous silt loam. The next part is pale brown, calcareous silt loam. The lower part to a depth of about 60 inches is stratified, grayish brown, calcareous silt loam and very pale brown, calcareous fine sandy loam. In places carbonates are within a depth of 20 inches.

Typically, the Kimo soil has a surface layer of very dark grayish brown silty clay loam about 9 inches thick. The subsurface layer is very dark brown and very dark grayish brown silty clay loam about 15 inches thick. The next layer is dark grayish brown and brown, friable silty clay loam about 11 inches thick. The upper part of the substratum is brown silt loam, and the lower part to a depth of about 60 inches is stratified, brown and pale brown, calcareous very fine sandy loam. In some places the depth to silt loam is less than 20 inches. In other places the soil is less clayey.

Included with these soils in mapping are small areas of Eudora soils that have 6 to 24 inches of sandy overwash, which was deposited by floodwater. These areas make up about 5 percent of the map unit.

Permeability is moderate in the Eudora soil. It is slow in the subsoil of the Kimo soil and moderate in the substratum. Natural fertility is high in the Eudora soil and medium in the Kimo soil. Available water capacity is high in both soils. Organic matter content is moderate. Runoff is slow. The surface layer of the Eudora soil is friable and can be easily tilled throughout a fairly wide range in moisture content. That of the Kimo soil is firm and should not be tilled during wet periods. The shrink-swell potential is low throughout the Eudora soil. It is high in the upper part of the Kimo soil and low in the substratum. The Kimo soil has a seasonal high water table at a depth of about 2 to 6 feet during the spring.

Nearly all of the acreage is used for cultivated crops. These soils are well suited to corn, grain sorghum, soybeans, wheat, and alfalfa. If cultivated crops are grown, flooding is a hazard on both soils. Wetness is a limitation on the Kimo soil. If the Kimo soil is tilled when it is too wet, surface compaction is a problem. It can be minimized by timely tillage. Minimizing tillage and leaving crop residue on the surface conserve moisture and help to maintain fertility. Returning crop residue to the soil and adding other organic material improve tilth and fertility, minimize surface crusting, and increase the rate of water infiltration.

Corn and soybeans are the main irrigated crops. Maintaining fertility and using water efficiently are the main concerns in managing the soils for irrigated crops. Wetness is a limitation on the Kimo soil. Returning crop residue to the soil and adding other organic material improve fertility and increase the rate of water infiltration. Controlling the rate of water application conserves water and lowers operating costs. Land leveling can conserve water and lower operating costs by improving the distribution of irrigation water.

The Eudora soil is generally unsuited to dwellings because of the flooding. Overcoming this hazard is difficult without major flood-control measures. This soil is moderately well suited to septic tank absorption fields and well suited to sewage lagoons. The flooding is a hazard on sites for septic tank absorption fields. Levees and dikes help to control floodwater. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the lagoon.

The Kimo soil is generally unsuited to dwellings because of the flooding and the wetness, to septic tank absorption fields because of the wetness and the slow permeability in the subsoil, and to sewage lagoons because of the wetness. Overcoming the hazard of flooding is difficult without major flood-control measures.

The land capability classification is IIw, and the range site is Loamy Lowland in areas of the Eudora soil and Clay Lowland in areas of the Kimo soil.

Fl—Florence-Labette complex, 3 to 15 percent slopes. These well drained, moderately sloping and strongly sloping soils are on ridgetops and side slopes that are dissected by many drainageways. The deep Florence soil is on the more sloping shoulder slopes and side slopes. The moderately deep Labette soil is on the less sloping ridgetops. Scattered coarse chert fragments are on the surface. Individual areas are irregular in shape and range from 50 to 5,000 acres in size. They are about 40 percent Florence soil and 30 percent Labette soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the Florence soil has a surface soil of very dark grayish brown cherty silt loam about 14 inches thick. The subsoil is about 42 inches thick. In sequence downward, it is dark grayish brown, firm cherty silty clay loam; dark brown, very firm very cherty silty clay; dark reddish brown, extremely firm very cherty clay; and reddish brown and red, extremely firm cherty clay. Cherty limestone bedrock is at a depth of about 56 inches.

Typically, the Labette soil has a surface layer of dark brown silt loam about 7 inches thick. The subsurface layer is dark brown silty clay loam about 5 inches thick. The subsoil is mottled, firm silty clay about 23 inches thick. The upper part is dark reddish brown, and the lower part is reddish brown and dark brown. Cherty limestone bedrock is at a depth of about 35 inches. In some areas the soil is grayer and is more than 40 inches deep over bedrock.

Included with these soils in mapping are small areas of Clime, Irwin, Martin, and Sogn soils. The moderately deep, calcareous Clime soils are on side slopes. The deep Irwin soils have a dark surface soil more than 24 inches thick. They are on ridgetops. The moderately well drained Martin soils are on the lower side slopes and on foot slopes. The shallow Sogn soils are on the breaks of side slopes. Included soils make up about 30 percent of the map unit.

Permeability is slow in the Labette soil and moderately slow in the Florence soil. Natural fertility is medium in the Labette soil and low in the Florence soil. Available water capacity is moderate in the Labette soil and low in the Florence soil. Runoff is rapid on both soils. Organic matter content is moderate. The shrink-swell potential is high in the subsoil of the Labette soil and moderate in the subsoil of the Florence soil. Root penetration is restricted by the limestone bedrock at a depth of about 35 inches in the Labette soil and at a depth of about 56 inches in the Florence soil.

Most areas are used as range. Because of the hazard of erosion and the chert fragments, which interfere with tillage, these soils are generally unsuited to cultivated crops. They are better suited to range. The native vegetation is dominantly big bluestem, little bluestem, and indiangrass. Overgrazing depletes the plant cover and causes deterioration of the plant community. Under these conditions, the more productive grasses are replaced by less productive grasses and by weeds, such as tall dropseed, Baldwin ironweed, and western ragweed. Proper stocking rates, a uniform distribution of grazing, timely deferment of grazing, timely burning, and rotation grazing help to keep the range in good condition. Controlled burning in late spring helps to remove woody plants and old thatch.

The Florence soil is moderately well suited to dwellings. The shrink-swell potential, the slope, and the content of cherty fragments are limitations on sites for dwellings without basements. Also, the depth to bedrock is a limitation on sites for dwellings with basements. The Labette soil is poorly suited to dwellings. The shrink-swell potential is a limitation. Also, the depth to bedrock is a limitation on sites for dwellings with basements. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling.

The Florence soil is generally unsuited to septic tank absorption fields because of the slow permeability and to sewage lagoons because of the slope. The Labette soil is generally unsuited to septic tank absorption fields because of the depth to bedrock and the slow permeability and to sewage lagoons because of the depth to bedrock and the slope.

The land capability classification is VIe, and the range site is Loamy Upland.

Gy—Gymer silty clay loam, 3 to 8 percent slopes. This deep, moderately sloping, well drained soil is on the side slopes of valley walls along the Kansas River. Individual areas are long and narrow and range from 20 to 300 acres in size.

Typically, the surface layer is very dark grayish brown silty clay loam about 6 inches thick. The subsurface layer is very dark brown silty clay loam about 5 inches thick. The subsoil is firm silty clay loam about 37 inches thick. The upper part is very dark grayish brown and dark brown, and the lower part is reddish brown and yellowish red and is mottled. The substratum to a depth of about 60 inches is yellowish red silty clay loam. In some areas where the subsoil has been mixed with the surface soil by tillage, the surface layer is lighter in color. In some of the steeper areas, the surface soil is thinner because of erosion.

Included with this soil in mapping are small areas of Morrill and Wymore soils in the higher positions on the landscape. Morrill soils have less clay and more sand in the subsoil than the Gymer soil. Wymore soils are grayer and more clayey in the subsoil than the Gymer soil. Included soils make up about 15 percent of the map unit.

Permeability is moderately slow in the Gymer soil. Runoff is medium. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate in the subsoil.

Most of the acreage is used for cultivated crops. The rest is used for tame and native grass pasture. Some areas of native grass have a partial stand of trees. This soil is moderately well suited to grain sorghum, soybeans, wheat, and alfalfa. Water erosion is a hazard if cultivated crops are grown. Reducing the number of tillage operations, planting winter cover crops, establishing grassed waterways, and applying a system of conservation tillage that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Some areas have slopes that are smooth enough and broad enough for terraces and contour farming.

This soil is moderately well suited to dwellings. The shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling.

Because of the moderately slow permeability, this soil is poorly suited to septic tank absorption fields. Enlarging the absorption field helps to overcome this limitation. The soil is moderately well suited to sewage lagoons. Seepage and slope are limitations. Sealing the lagoon helps to control seepage. Some land shaping is commonly needed.

The land capability classification is IIIe, and the range site is Loamy Upland.

He—Haynie very fine sandy loam, occasionally flooded. This deep, nearly level, well drained soil is on stream terraces along the Kansas River. Individual areas are elongated and range from 20 to 200 acres in size.

Typically, the surface layer is very dark grayish brown very fine sandy loam about 9 inches thick. The substratum is calcareous silt loam. The upper part is dark brown, the next part is grayish brown, and the lower part to a depth of about 60 inches is brown and stratified. In some places the soil is darker below a depth of 10 inches. In other places the surface layer is calcareous. In some areas the soil is more clayey.

Included with this soil in mapping are small areas of Kimo and Sarpy soils. The somewhat poorly drained Kimo soils are in depressions and old channels. They are more clayey in the upper part than the Haynie soil. The excessively drained Sarpy soils are more sandy than the Haynie soil and are generally closer to the Kansas River. Included soils make up about 15 percent of the map unit.

Permeability is moderate in the Haynie soil. Runoff is slow. Available water capacity is high. Organic matter content is moderate, and natural fertility is medium. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is low throughout the soil.

Nearly all of the acreage is used for cultivated crops. This soil is well suited to wheat, corn, grain sorghum, and soybeans. Flooding and soil blowing are hazards if cultivated crops are grown. Crop yields are reduced in some years because of the flooding. Reducing the number of tillage operations, planting winter cover crops, and applying a system of conservation tillage that leaves all or part of the crop residue on the surface help to control soil blowing. Returning crop residue to the soil and adding other organic material improve tilth and fertility, minimize surface crusting, and increase the rate of water infiltration. Crop rotations help to control weeds, plant diseases, and insect carry-over.

Corn, soybeans, and truck crops are the main irrigated crops. Using water efficiently and maintaining soil fertility are management concerns. Leaving crop residue on the surface helps to maintain tilth and fertility. Controlling the rate of water application conserves irrigation water and lowers operating costs.

This soil is generally unsuited to building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is IIw, and the range site is Loamy Lowland.

Ib—Irwin silty clay loam, 1 to 3 percent slopes. This deep, gently sloping, moderately well drained soil is on ridgetops and shoulder slopes. Individual areas are irregular in shape and range from 10 to 900 acres in size.

Typically, the surface soil is very dark brown silty clay loam about 12 inches thick. The subsoil is about 30 inches thick. It is mottled and very firm. The upper part is very dark grayish brown and very dark brown silty clay, the next part is very dark grayish brown and dark grayish brown clay, and the lower part is dark brown silty clay. The substratum to a depth of about 60 inches is dark reddish brown, mottled clay. In some places the surface layer is silty clay. In other places the depth to bedrock is less than 40 inches.

Included with this soil in mapping are small areas of Ladysmith soils and slickspots. Ladysmith soils are in the higher positions on the landscape. They are grayer in the surface layer and in the upper part of the subsoil than the Irwin soil. The slickspots have more exchangeable sodium than the Irwin soil. They are in slight depressions. Included areas make up about 20 percent of the map unit.

Permeability is very slow in the Irwin soil. Runoff is medium. Available water capacity is moderate, and natural fertility is medium. Organic matter content is moderate. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is high in the subsoil.

Most of the acreage is used for cultivated crops. The rest is used as range or pasture (fig. 7). This soil is well suited to wheat, alfalfa, grain sorghum, and soybeans. Water erosion is a hazard if cultivated crops are grown. Reducing the number of tillage operations, planting winter cover crops, farming on the contour, establishing grassed waterways, terracing, and applying a system of conservation tillage that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve tilth and fertility, minimize crusting, and increase the rate of water infiltration.

This soil is suited to range and pasture. The native vegetation is dominantly big bluestem, little bluestem, indiangrass, and switchgrass. Overgrazing depletes the plant cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and by weeds, such as tall dropseed, western ragweed, and Baldwin ironweed. Proper stocking rates and rotation grazing help to keep the range in good condition. Early mowing of hay allows the plants to recover and store food before the first frost. Applications of fertilizer increase forage production in the areas used as grass pasture. Woody plants, such as redcedar, invade in some areas. They can be removed by timely burning.

This soil is poorly suited to dwellings. The shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around

Figure 7.—Brome pasture and milo in an area of Irwin silty clay loam, 1 to 3 percent slopes.

the foundations help to prevent the structural damage caused by shrinking and swelling.

Because of the very slow permeability, this soil is generally unsuited to septic tank absorption fields. It is moderately well suited to sewage lagoons. The slope is a limitation. Some land shaping is needed.

The land capability classification is IIIe, and the range site is Clay Upland.

Id—Irwin silty clay loam, 3 to 7 percent slopes. This deep, moderately sloping, moderately well drained soil is on side slopes. Individual areas are irregular in shape and range from 50 to 300 acres in size.

Typically, the surface layer is very dark brown silty clay loam about 9 inches thick. The subsoil is very firm clay about 41 inches thick. The upper part is very dark brown, the next part is very dark grayish brown and dark brown and is mottled, and the lower part is brown and grayish brown and is mottled. The substratum to a depth of about 60 inches is brownish yellow and light olive brown, mottled silty clay. In some places the surface layer is silty clay. In other places the depth to bedrock is less than 40 inches.

Included with this soil in mapping are small areas of Labette and Martin soils. The moderately deep Labette soils are on shoulder slopes below the Irwin soil. Martin soils are on foot slopes below the Irwin soil. They are grayer than the Irwin soil. Included soils make up about 10 percent of the map unit.

Permeability is very slow in the Irwin soil. Runoff is medium. Available water capacity and organic matter content are moderate. Natural fertility is medium. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is high in the subsoil.

Most of the acreage is used for range or native hay. The remaining acreage is used for cultivated crops. This soil is moderately well suited to wheat, grain sorghum, soybeans, and alfalfa. Water erosion is a hazard if cultivated crops are grown. Reducing the number of tillage operations, farming on the contour, establishing grassed waterways, terracing, and applying a system of conservation tillage that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve tilth and fertility, minimize crusting, and increase the rate of water infiltration.

This soil is suited to range. The native vegetation is dominantly big bluestem, indiangrass, and switchgrass. Overgrazing depletes the plant cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and by weeds, such as tall dropseed, western ragweed, and Baldwin ironweed. Proper stocking rates and rotation grazing help to keep the range in good condition. Early mowing of hay allows the plants to recover and store food before the first frost. Applications of fertilizer increase forage production in the areas used as grass pasture. Woody plants, such as redcedar and Osageorange, invade in some areas. They can be removed by timely burning.

This soil is poorly suited to dwellings. The shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling.

This soil is generally unsuited to septic tank absorption fields because of the very slow permeability. It is moderately well suited to sewage lagoons. The slope is a limitation. Some land shaping is needed.

The land capability classification is IVe, and the range site is Clay Upland.

Iv—Ivan silt loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains. Individual areas are irregular in shape and range from 25 to 1,000 acres in size.

Typically, the surface layer is very dark grayish brown, calcareous silt loam about 8 inches thick. The subsurface layer is very dark gray, calcareous silt loam about 13 inches thick. The next layer is very dark grayish brown, friable, calcareous silt loam about 15 inches thick. The substratum to a depth of about 60 inches is dark grayish brown, calcareous silt loam. In some places the soil has no carbonates. In other places the soil is more clayey throughout.

Included with this soil in mapping are small areas of the somewhat poorly drained Chase soils and the well drained Reading soils. Both soils are noncalcareous. They are on the slightly higher stream terraces. Also included are steep stream banks and gravel bars. Included areas make up about 10 percent of the map unit.

Permeability is moderate in the Ivan soil. Runoff is slow. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate in the subsoil.

Most of the acreage is used for cultivated crops. The remainder is used as range, pasture, or woodland. This soil is well suited to corn, soybeans, grain sorghum, wheat, and alfalfa. Crop yields are reduced in some years because of the flooding. Reducing the number of tillage operations and leaving crop residue on the surface conserve moisture, increase the rate of water infiltration, and improve tilth. Crop rotations help to control weeds, plant diseases, and insect carry-over.

This soil is well suited to range and tame grasses for hay or pasture. The native vegetation is dominantly big bluestem, indiangrass, and switchgrass with an overstory of eastern cottonwood, green ash, and hackberry trees. Control of brush and trees and the distribution of grazing are the main management concerns. In some areas, the grass is overgrazed and in poor condition and the more desirable grasses have been replaced by less productive grasses and by weeds. The cattle tend to congregate around the water facilities and shade trees in these areas. Using a rotation grazing system and restricting grazing to winter increase forage production. Controlled burning, spraying, and selective cutting help to control the woody plants. Applications of fertilizer and timely mowing of tame grass pasture increase plant vigor and production.

This soil is well suited to trees. Plant competition is moderate. Tree seedlings and cuttings survive and grow well only if competing plants are controlled. Harvesting mature trees, thinning, and planting desirable species help to keep the woodland in good condition.

This soil is generally unsuited to building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is IIw, and the range site is Loamy Lowland.

Ix—Ivan silty clay loam, channeled. This deep, nearly level, well drained soil is on narrow flood plains that are dissected by stream channels. It is frequently flooded for very brief periods each year. Individual areas are long and narrow and range from 25 to 150 acres in size.

Typically, the surface layer is very dark grayish brown, calcareous silty clay loam about 6 inches thick. The subsurface layer is about 21 inches thick. The upper part is very dark brown, calcareous silty clay loam, and the lower part is very dark grayish brown, calcareous silt loam. The next layer is very dark grayish brown, calcareous silty clay loam about 13 inches thick.

The substratum to a depth of about 60 inches is very dark grayish brown, calcareous silt loam. In some places the soil is noncalcareous. In other places it is less clayey throughout.

Included with this soil in mapping are small areas of Martin and Reading soils and soils similar to the Ivan soil that are moderately deep to sand and coarse gravel or rock. Martin and Reading soils are noncalcareous. Martin soils are on foot slopes. They are more clayey in the subsoil than the Ivan soil. Reading soils are on stream terraces. The moderately deep soils are adjacent to the stream channels. Also included are steep stream banks, rock and gravel bars, and scour plains. Included areas make up about 20 percent of the map unit.

Permeability is moderate in the Ivan soil. Runoff is slow. Available water capacity and natural fertility are high. Organic matter content is moderate. The shrink-swell potential is moderate in the subsoil.

Most of the acreage is used as range or woodland. A few areas are used for cultivated crops. This soil is generally unsuited to cultivated crops, however, because of the frequent flooding. The use of machinery is restricted along the meandering stream channels.

This soil is better suited to range and tame grasses for hay or pasture than to cultivated crops. The native vegetation is dominantly big bluestem, indiangrass, and switchgrass with an overstory of eastern cottonwood, green ash, and hackberry trees. Control of brush and the distribution of grazing are the main management concerns. In some areas the range is overgrazed and in poor condition. Cattle tend to congregate near the water and shade trees in these areas, and the more productive grasses are replaced by less productive grasses and by weeds. Using a rotation grazing system and restricting grazing to winter increase forage production. Controlled burning, spraying, and selective cutting help to remove the woody plants. Applications of fertilizer and timely mowing of tame grasses increase plant vigor and production.

This soil is well suited to trees. Plant competition is moderate. Tree seedlings and cuttings survive and grow well only if competing plants are controlled. Harvesting mature trees and thinning and planting desirable species help to keep the woodland in good condition.

This soil is generally unsuited to building site development because of the frequent flooding.

The land capability classification is Vw, and the range site is Loamy Lowland.

La—Labette silty clay loam, 2 to 5 percent slopes. This moderately deep, gently sloping and moderately sloping, well drained soil is on shoulder slopes. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is very dark brown silty clay loam about 8 inches thick. The subsoil is very firm silty clay about 29 inches thick. The upper part is very dark grayish brown, the next part is dark brown and brown and is mottled, and the lower part is dark reddish brown and mottled. Cherty limestone bedrock is at a depth of about 37 inches. In places, the depth to bedrock is more than 40 inches and the subsoil is grayer.

Included with this soil in mapping are small areas of Florence, Irwin, and Sogn soils. Florence soils are below the Labette soil on the landscape. They contain more chert fragments than the Labette soil. The moderately well drained Irwin soils are on ridgetops. The shallow Sogn soils are on shoulder slopes below the Labette soil. Included soils make up about 25 percent of the map unit.

Permeability is slow in the Labette soil. Runoff is medium. Available water capacity and organic matter content are moderate. Natural fertility is medium. The surface layer is firm and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is high in the subsoil. Root penetration is restricted by the limestone bedrock at a depth of about 37 inches.

Most areas are used as range. The remaining areas are used for cultivated crops. This soil is moderately well suited to wheat and to grain sorghum. Water erosion is a hazard if cultivated crops are grown. It can be controlled by reducing the number of tillage operations, farming on the contour, establishing grassed waterways, terracing, and applying a system of conservation tillage that leaves all or part of the crop residue on the surface. Returning crop residue and adding other organic material to the soil improve tilth and fertility, minimize crusting, and increase the rate of water infiltration.

This soil is suited to range. The native vegetation is dominantly big bluestem, little bluestem, and indiangrass. Overgrazing depletes the plant cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and by weeds, such as tall dropseed, sideoats grama, western ragweed, and Missouri goldenrod. Proper stocking rates, rotation grazing, and timely deferment of grazing help to keep the range in good condition. Early mowing of hay allows the plants to recover and store food before the first frost.

This soil is poorly suited to dwellings. The shrink-swell potential is a limitation on sites for dwellings with or without basements. Also, the depth to bedrock is a limitation on sites for dwellings with basements. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling.

This soil is generally unsuited to sanitary facilities because of the depth to bedrock.

The land capability classification is IIIe, and the range site is Loamy Upland.

Lm—Ladysmith silty clay loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on broad ridgetops. Individual areas are irregular in shape and range from 50 to 2,400 acres in size.

Typically, the surface layer is black silty clay loam about 8 inches thick (fig. 8). The subsoil is about 42 inches thick. The upper part is very dark brown, very firm silty clay; the next part is very dark grayish brown, dark grayish brown, and dark gray, mottled, very firm clay; and the lower part is grayish brown, mottled, very firm silty clay. The substratum to a depth of about 60 inches is light brownish gray, mottled silty clay. In some places the surface layer and the upper part of the subsoil are lighter colored above a depth of 20 inches. In other places calcium carbonates are within a depth of 30 inches.

Included with this soil in mapping are small areas of the moderately well drained Irwin soils in the lower positions on the landscape. These soils make up about 10 percent of the map unit.

Permeability is very slow in the Ladysmith soil. Runoff is slow. Available water capacity and organic matter content are moderate. Natural fertility is high. The surface layer is firm and can be easily tilled only within a narrow range in moisture content. The shrink-swell potential is high in the subsoil. A perched seasonal high water table is at a depth of about 2 to 3 feet during the spring months.

Most of the acreage is used for cultivated crops, and the rest is used for native or tame grasses for hay or grazing. This soil is well suited to wheat, soybeans, grain sorghum, and alfalfa. Crop yields can be reduced by wetness. They also can be reduced during periods of drought because the clayey subsoil does not readily release water to plants. Reducing the number of tillage

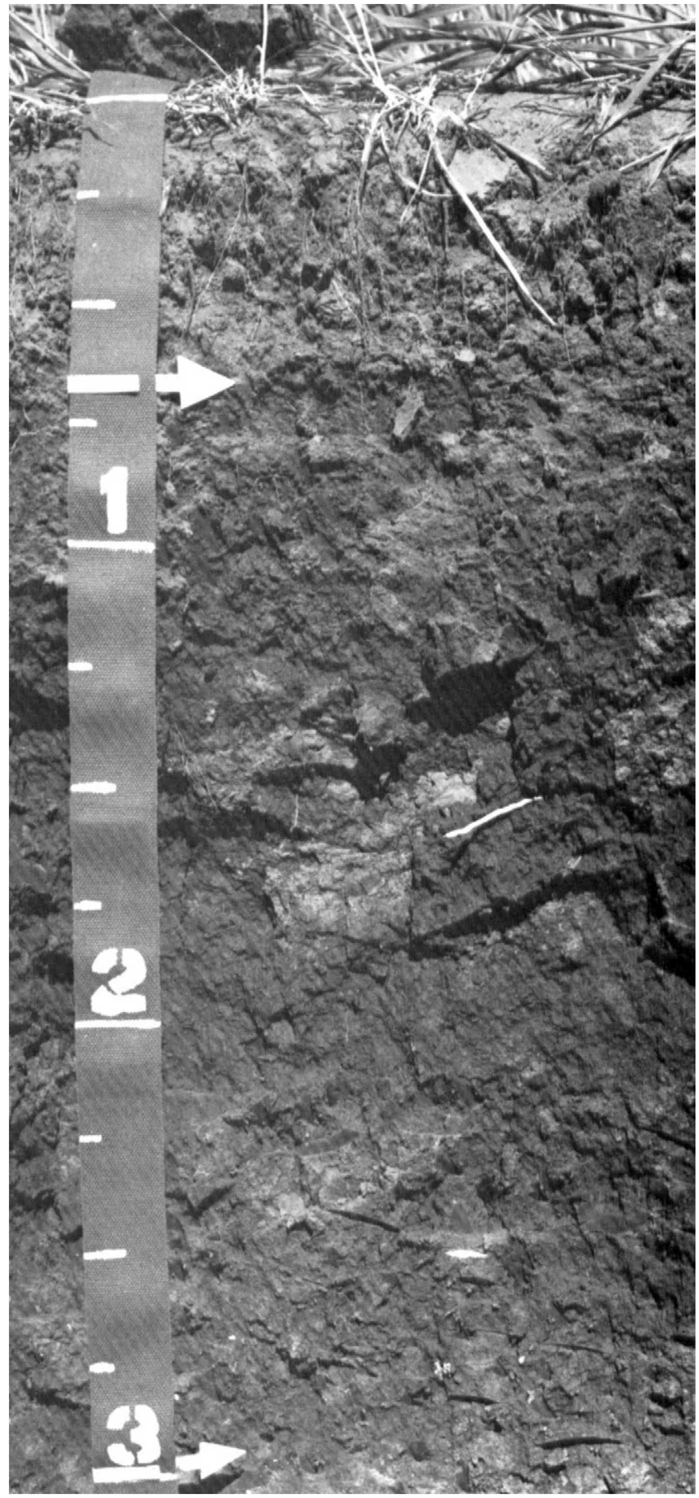

Figure 8.—Typical profile of Ladysmith silty clay loam. Depth is marked in feet.

operations, applying a system of conservation tillage that leaves all or part of the crop residue on the surface, and adding other organic material improve tilth and fertility, minimize crusting, and increase the rate of water infiltration.

This soil is suited to tame and native grasses for hay or pasture. The native vegetation is dominantly big bluestem, little bluestem, and switchgrass. If the range is overgrazed, these grasses are replaced by less desirable grasses and by weeds, such as tall dropseed, sideoats grama, and western ragweed. Grazing when the soil is too wet causes surface compaction. Proper stocking rates, restricted use during wet periods, and timely deferment of grazing help to keep the range in good condition. Early mowing of these grasses for hay allows the plants to recover and store food before the first frost. Applications of fertilizer are generally needed to improve the vigor, quality, and quantity of tame grasses.

This soil is poorly suited to dwellings. The shrink-swell potential is a limitation. Also, wetness is a limitation on sites for dwellings with basements. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with coarse textured material around the foundations help to prevent the structural damage caused by wetness and by shrinking and swelling.

This soil is well suited to sewage lagoons. It is generally unsuited to septic tank absorption fields because of the wetness and the very slow permeability.

The land capability classification is IIs, and the range site is Clay Upland.

Mb—Martin silty clay loam, 3 to 7 percent slopes. This deep, moderately sloping, moderately well drained soil is on side slopes and foot slopes. Individual areas are irregular in shape and range from 20 to 800 acres in size.

Typically, the surface soil is black silty clay loam about 14 inches thick. The subsoil extends to a depth of about 60 inches. It is mottled, very firm silty clay. The upper part is very dark grayish brown, and the lower part is dark grayish brown. In places the depth to shale is less than 40 inches.

Included with this soil in mapping are small areas of Clime, Elmont, Ivan, and Wamego soils and limestone outcrops. The moderately deep, calcareous Clime soils are on the upper side slopes. Elmont soils are in positions on the landscape similar to those of the Martin soil. They are less clayey than the Martin soil. The silty Ivan soils are on flood plains. The moderately deep Wamego soils are on side slopes above the Martin soil. The limestone outcrops are on shoulder slopes. Included areas make up about 20 percent of the map unit.

Permeability is slow in the Martin soil. Runoff is medium. Available water capacity is high, and organic matter content is moderate. Natural fertility is medium. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is high in the subsoil. A perched seasonal high water table is at a depth of about 2 to 3 feet in winter and early spring.

Most areas are used as range or pasture. The rest are used for cultivated crops or for timber. This soil is moderately well suited to wheat, soybeans, grain sorghum, and alfalfa. Water erosion is a hazard if cultivated crops are grown. It can be controlled by reducing the number of tillage operations, farming on the contour, establishing grassed waterways, terracing, and applying a system of conservation tillage that leaves all or part of the crop residue on the surface. Returning crop residue to the soil and adding other organic material improve tilth and fertility, minimize crusting, and increase the rate of water infiltration.

This soil is suited to range. The native vegetation is dominantly big bluestem, little bluestem, indiangrass, and switchgrass. In overgrazed areas the less productive grasses, such as tall dropseed and sideoats grama, make up a larger percentage of the plant community. Proper stocking rates, rotation grazing, and timely deferment of grazing and haying help to keep the range in good condition. Early mowing of hay allows the plants to recover and store food before the first frost. Applications of fertilizer increase forage production in areas of tame grasses. Woody plants, such as redcedar, invade in some areas. They can be removed by timely burning.

This soil is poorly suited to dwellings. The shrink-swell potential is a limitation. Also, wetness is a limitation on sites for dwellings with basements. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with coarse textured material around the foundations help to prevent the structural damage caused by wetness and by shrinking and swelling.

This soil is only moderately well suited to sewage lagoons because of the slope. Some land shaping is commonly needed. Because of the slow permeability and the wetness, this soil is generally unsuited to septic tank absorption fields.

The land capability classification is IIIe, and the range site is Loamy Upland.

Mc—Martin silty clay loam, 3 to 7 percent slopes, eroded. This deep, moderately sloping, moderately well drained soil is on side slopes and foot slopes. Sheet erosion has removed more than half of the original surface layer in most places. In a few places, the subsoil is exposed at the surface and there are some rills and shallow gullies that can be crossed with farm equipment. Individual areas of this soil are irregular in shape and range from 10 to 50 acres in size.

Typically, the surface layer is black silty clay loam about 6 inches thick. The subsoil is about 45 inches thick. It is mottled. The upper part is very dark grayish brown and dark grayish brown, very firm silty clay; the next part is dark grayish brown, very firm clay; and the lower part is dark grayish brown, very firm silty clay. The substratum to a depth of about 60 inches is grayish brown, mottled silty clay. In places the depth to shale is less than 40 inches.

Included with this soil in mapping are small areas of Clime soils and limestone outcrops. The moderately deep, calcareous Clime soils are on the upper side slopes. Limestone outcrops are throughout the unit. Included areas make up about 15 percent of the map unit.

Permeability is slow in the Martin soil. Runoff is rapid. Available water capacity is moderate, and organic matter content is low. Natural fertility is medium. The surface layer is firm and can be easily tilled within only a narrow range in moisture content. The shrink-swell potential is high in the subsoil. A perched seasonal high water table is at a depth of about 2 to 3 feet in winter and early spring.

Nearly all of the acreage formerly was cultivated. About two-thirds is still used for cultivated crops, mainly wheat, soybeans, and grain sorghum. Some areas have been reseeded to grass or are abandoned cropland. Further erosion is the main hazard. Terracing, farming on the contour, establishing grassed waterways, and applying a system of conservation tillage that leaves all or part of the crop residue on the surface help to control further erosion. Returning crop residue to the soil and adding other organic material improve tilth and fertility, minimize crusting, and increase the rate of water infiltration.

This soil is better suited to pasture and range. A cover of grass is effective in controlling erosion. Range seeding is needed to restore the productivity of abandoned cropland. In places land smoothing is needed before the grasses are seeded. Applications of fertilizer increase forage production in the areas used for tame grass pasture.

This soil is poorly suited to dwellings. The shrink-swell potential is a limitation. Also, wetness is a limitation on sites for dwellings with basements. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by wetness and by shrinking and swelling. Some land shaping may be necessary to close gullies.

This soil is only moderately well suited to sewage lagoons because of the slope. Some land shaping is needed to compensate for the slope and to close the gullies. This soil is generally unsuited to septic tank absorption fields because of the slow permeability and the wetness.

The land capability classification is IVe, and the range site is Loamy Upland.

Mr—Morrill loam, 4 to 7 percent slopes. This deep, moderately sloping, well drained soil is on side slopes. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is very dark brown loam about 8 inches thick. The subsoil is clay loam about 29 inches thick. The upper part is dark brown and friable, the next part is dark brown and reddish brown and is firm, and the lower part is reddish brown and firm. The substratum to a depth of about 60 inches is reddish brown, mottled clay loam. In some places the lower part of the subsoil is clay and mottled. In other places stones and boulders are on the surface.

Included with this soil in mapping are small areas of Martin, Pawnee, Sogn, and Wymore soils. The moderately well drained Martin soils are on foot slopes below the Morrill soil. The moderately well drained Pawnee soils are on side slopes above the Morrill soil. They are more clayey than the Morrill soil. The shallow Sogn soils are on slope breaks below the Morrill soil. Wymore soils are on ridgetops above the Morrill soil. They are grayer and more clayey than the Morrill soil. Included soils make up about 25 percent of the map unit.

Permeability is moderately slow in the Morrill soil. Runoff is medium. Available water capacity is high. Organic matter content is moderate, and natural fertility is medium. The surface layer is friable and can be easily tilled throughout a wide range in moisture content. The shrink-swell potential is moderate in the subsoil.

About half of the acreage is used for cultivated crops, and the remainder is used as range or for native hay. This soil is moderately well suited to wheat, grain sorghum, and alfalfa. Water erosion is a hazard if cultivated crops are grown. It can be controlled by reducing the number of tillage operations, farming on the contour, establishing grassed waterways, terracing, and applying a system of conservation tillage that leaves all or part of the crop residue on the surface. Returning crop residue to the soil and adding other organic material improve tilth and fertility, minimize crusting, and increase the rate of water infiltration.

This soil is suited to range. The native vegetation is dominantly big bluestem, little bluestem, and indiangrass. Continual overgrazing results in decreased production of the major tall grasses and allows less productive grasses, such as tall dropseed and sideoats grama, to make up a larger percentage of the plant community. Proper stocking rates, timely deferment of grazing, and proper distribution of salt, minerals, and water help to keep the range in good condition. Woody plants invade in some areas. Controlled burning in late spring helps to remove the woody plants and also promotes the uniform distribution of grazing.

This soil is only moderately well suited to dwellings because of the shrink-swell potential. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling.

This soil is only moderately well suited to septic tank absorption fields because of the moderately slow permeability. Enlarging the absorption field helps to overcome the slow absorption of liquid waste. The soil is only moderately well suited to sewage lagoons because of seepage and the slope. Sealing the lagoon helps to control seepage. Land shaping can help to compensate for the slope. Also, the less sloping areas can be selected as sites for the lagoons.

The land capability classification is IIIe, and the range site is Loamy Upland.

Ms—Morrill loam, 5 to 12 percent slopes, very stony. This deep, moderately sloping and strongly sloping, well drained soil is on narrow ridgetops and side slopes. Stones and boulders are scattered over the surface. The stones and boulders are rounded and range from 1 inch to 5 feet in diameter. They cover 1 to 3 percent of the surface and are 1 to 40 feet apart. Individual areas of this soil are irregular in shape and range from 10 to 300 acres in size.

Typically, the surface layer is very dark grayish brown loam about 10 inches thick. The subsurface layer is dark brown loam about 5 inches thick. The subsoil is about 27 inches thick. The upper part is dark brown, friable clay loam; the next part is reddish brown, firm clay loam; and the lower part is reddish brown, firm gravelly sandy clay loam. The substratum to a depth of about 60 inches is brown and strong brown gravelly sandy clay loam. In some places the lower part of the subsoil is clay. In other places the surface layer is less than 10 inches thick.

Included with this soil in mapping are small areas of Clime and Pawnee soils. The moderately deep, calcareous Clime soils are on side slopes below the Morrill soil. Pawnee soils have a subsoil that is more clayey and mottled than that of the Morrill soil. They are on the upper side slopes and ridgetops above the Morrill soil. Included soils make up about 25 percent of the map unit.

Permeability is moderately slow in the Morrill soil. Runoff is rapid. Available water capacity is high. Organic matter content is moderate, and natural fertility is medium. The shrink-swell potential is moderate in the subsoil.

Nearly all of the acreage is used as range or supports native vegetation. Because of the slope, the hazard of erosion, and the stones on the surface, this soil is generally unsuited to cultivated crops. It is better suited to range. The native vegetation is dominantly big bluestem, little bluestem, and indiangrass. Overgrazing depletes the plant cover, and continued overgrazing causes the desirable grasses to be replaced by less productive grasses and by weeds, such as tall dropseed, sideoats grama, western ragweed, and Missouri goldenrod. Proper stocking rates, timely deferment and uniform distribution of grazing, and a program of brush control help to keep the range in good condition.

This soil is only moderately well suited to dwellings because of the moderate shrink-swell potential and the slope. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling. Land shaping can help to compensate for the slope. Also, the less sloping areas can be selected. Some extra costs may be incurred because of the many stones and boulders.

This soil is only moderately well suited to septic tank absorption fields because of the moderately slow permeability. Enlarging the absorption field helps to overcome the slow absorption of liquid waste. This soil is poorly suited to sewage lagoons. The slope is a limitation. Land shaping can help to compensate for the slope. Also, the less sloping areas can be selected.

The land capability classification is VIe, and the range site is Loamy Upland.

Pa—Pawnee clay loam, 1 to 3 percent slopes. This deep, gently sloping, moderately well drained soil is on the upper side slopes and narrow ridgetops. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is very dark brown clay loam about 5 inches thick. The subsurface layer is very dark grayish brown clay loam about 5 inches thick. The subsoil is mottled, very firm clay about 39 inches thick. The upper part is dark grayish brown and very dark grayish brown, the next part is brown, and the lower part is grayish brown and brown. The substratum to a depth of about 60 inches is grayish brown, mottled clay loam. In places the subsoil is redder. In some areas stones and boulders are on the surface. In other areas the soil contains less sand.

Included with this soil in mapping are small areas of the well drained Morrill soils on side slopes below the Pawnee soil. They make up about 15 percent of the map unit.

Permeability is slow in the Pawnee soil. Runoff is medium. Natural fertility also is medium. Organic matter content and available water capacity are moderate. The surface layer is friable but can be easily tilled only within a narrow range in moisture content. The shrink-swell potential is high in the subsoil (fig. 9). A perched seasonal high water table is at a depth of about 1 to 3 feet in spring.

About half of the acreage is used for cultivated crops, and the remainder is used as range or for hay. This soil is well suited to wheat, soybeans, and grain sorghum. Water erosion is a hazard if cultivated crops are grown. It can be controlled by reducing the number of tillage operations, farming on the contour, establishing grassed waterways, terracing, and applying a system of conservation tillage that leaves all or part of the crop residue on the surface. Returning crop residue to the soil and adding other organic material improve tilth and fertility, minimize crusting, and increase the rate of water infiltration.

This soil is suited to range. Native vegetation is dominantly big bluestem, indiangrass, switchgrass, and little bluestem. In overgrazed areas less productive grasses, such as tall dropseed, make up a larger percentage of the plant community. Proper stocking rates, rotation grazing, and timely deferment of grazing and haying help to keep the range in good condition. Early mowing of hay allows the plants to recover and store food before the first frost. Proper placement of salt, minerals, and water, along with timely spring burning, can improve the distribution of grazing. Applications of fertilizer and timely mowing of tame grass pasture increase plant vigor, quality, and quantity.

This soil is poorly suited to dwellings. The shrink-swell potential and the wetness are limitations. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by wetness and by shrinking and swelling.

This soil is only moderately well suited to sewage lagoons because of the slope. Some land shaping may be needed. The soil is generally unsuited to septic tank absorption fields because of the slow permeability and the wetness.

The land capability classification is IIe, and the range site is Clay Upland.

Pn—Pawnee clay loam, 3 to 7 percent slopes. This deep, moderately sloping, moderately well drained soil is on side slopes. Individual areas are irregular in shape and range from 10 to 1,000 acres in size.

Typically, the surface layer is very dark brown clay loam about 11 inches thick. The subsurface layer is very dark grayish brown, mottled clay loam about 6 inches thick. The subsoil is mottled and very firm to a depth of about 60 inches. The upper part is dark grayish brown clay; the next part is dark brown, brown, and pale brown clay; and the lower part is pale brown and light gray clay loam. In some places the subsoil is redder, and in other places it is less clayey. In some areas the surface layer is clay. In other areas stones and boulders are on the surface.

Included with this soil in mapping are small areas of the well drained Morrill soils on the lower side slopes. They make up about 10 percent of the map unit.

Permeability is slow in the Pawnee soil. Runoff is medium. Natural fertility also is medium. Organic matter content and available water capacity are moderate. The surface layer is friable but can be easily tilled only within a narrow range in moisture content. The shrink-swell potential is high in the subsoil. A perched seasonal high water table is at a depth of about 1 to 3 feet in spring.

Over half of the acreage is used for cultivated crops, and the remainder is used as range or for hay. This soil is moderately well suited to wheat, soybeans, and grain sorghum. Water erosion is a hazard if cultivated crops are grown. It can be controlled by reducing the number of tillage operations, farming on the contour, establishing grassed waterways, terracing, and applying a system of conservation tillage that leaves all or part of the crop residue on the surface. Returning crop residue to the soil and adding other organic material improve

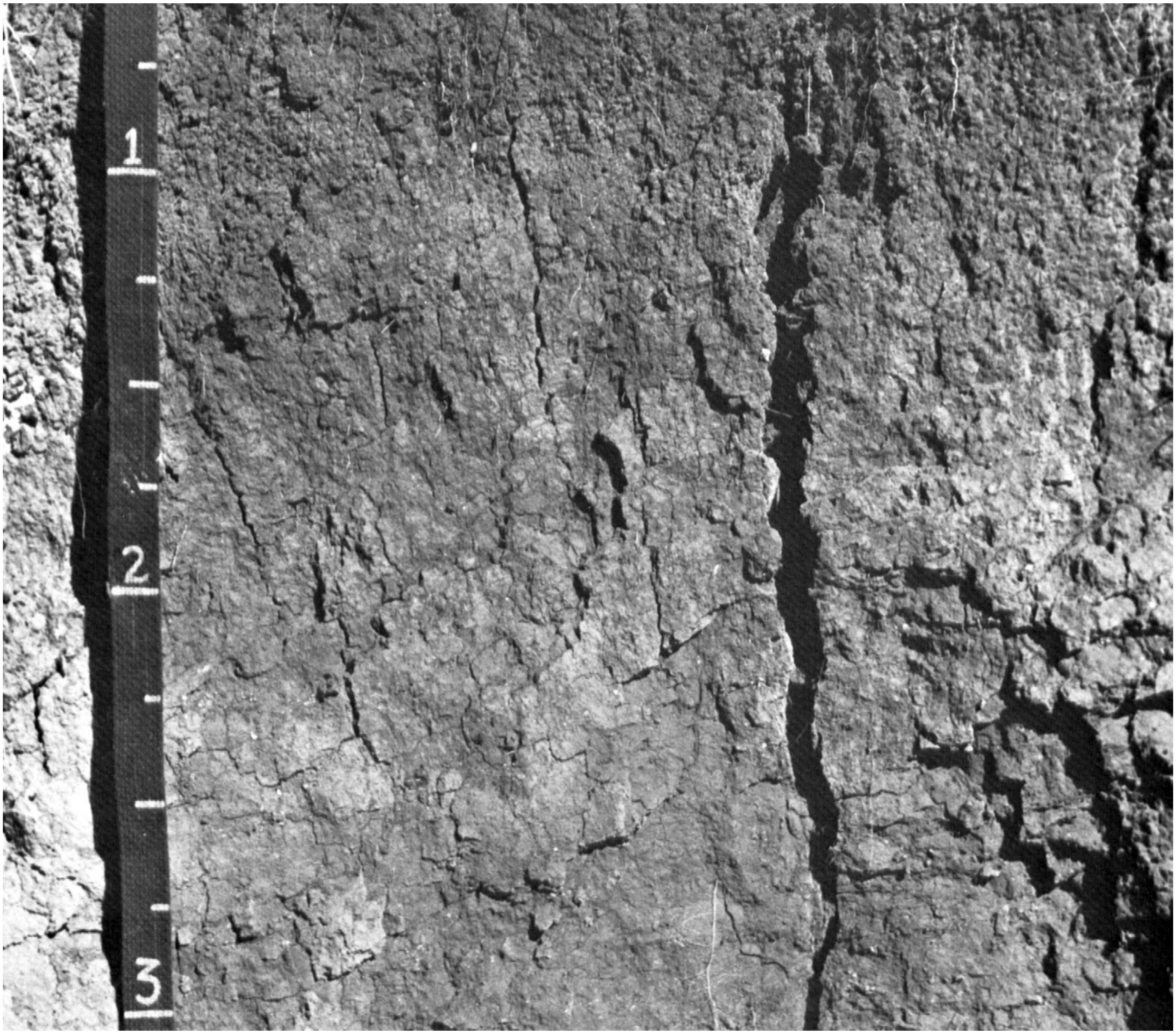

Figure 9.—Profile of Pawnee clay loam, 1 to 3 percent slopes. The large cracks in the subsoil are caused by shrinking and swelling. Depth is marked in feet.

tilth and fertility, minimize crusting, and increase the rate of water infiltration.

This soil is suited to range. The native vegetation is dominantly big bluestem, indiangrass, switchgrass, and little bluestem. In overgrazed areas less productive grasses, such as tall dropseed, make up a larger percentage of the plant community. Proper stocking rates, rotation grazing, and timely deferment of grazing and haying help to keep the range in good condition. Early mowing of hay allows the plants to recover and store food before the first frost. Proper placement of salt, minerals, and water, along with timely spring burning, can improve the distribution of grazing. Applications of fertilizer and timely mowing of tame grass pasture increase plant vigor, quality, and quantity.

This soil is poorly suited to dwellings. The shrink-swell potential and the wetness are limitations. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by wetness and by shrinking and swelling.

This soil is only moderately well suited to sewage lagoons because of the slope. Land shaping can compensate for the slope. The soil is generally unsuited to septic tank absorption fields because of the slow permeability and the wetness.

The land capability classification is IIIe, and the range site is Clay Upland.

Po—Pawnee clay loam, 3 to 7 percent slopes, eroded. This deep, moderately sloping, moderately well drained soil is on side slopes. Sheet erosion has removed more than half of the original surface layer in most places. In a few places, the subsoil is exposed at the surface and there are some rills and shallow gullies that can be crossed with farm equipment. Individual areas of this soil are irregular in shape and range from 10 to 75 acres in size.

Typically, the surface layer is very dark grayish brown and dark grayish brown clay loam about 6 inches thick. The subsoil is mottled, very firm clay about 38 inches thick. The upper part is dark grayish brown, the next part is grayish brown, and the lower part is brown. The substratum to a depth of about 60 inches is light brownish gray and pale brown, mottled sandy clay loam. In places the surface layer and subsoil are redder.

Included with this soil in mapping are small areas of the well drained Morrill soils on the lower side slopes. They make up about 10 percent of the map unit.

Permeability is slow in the Pawnee soil. Runoff is rapid. Natural fertility and organic matter content are low. Available water capacity is moderate. The surface layer is firm, and tilth is poor. The shrink-swell potential is high in the subsoil. A perched seasonal high water table is at a depth of about 1 to 3 feet in spring.

Nearly all areas formerly were cultivated, but only about half are still used for cultivated crops, mainly wheat, soybeans, and grain sorghum. The rest have been reseeded to grass or are abandoned cropland. This soil is poorly suited to cultivated crops. Further erosion is the main hazard. Terracing, farming on the contour, establishing grassed waterways, and applying a system of conservation tillage that leaves all or part of the crop residue on the surface help to control further erosion. Returning crop residue to the soil and adding other organic material improve tilth and fertility, minimize crusting, and increase the rate of water infiltration.

This soil is better suited to pasture and range. A cover of grass is effective in controlling erosion. Range seeding is needed to restore the productivity of abandoned cropland. In places land smoothing is needed before the grasses are seeded. Applications of fertilizer increase forage production in the areas used for tame grass pasture.

This soil is poorly suited to dwellings. The shrink-swell potential and the wetness are limitations. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by wetness and by shrinking and swelling. Some land shaping may be necessary to close gullies.

This soil is only moderately well suited to sewage lagoons because of the slope. Land shaping can compensate for the slope. The soil is generally unsuited to septic tank absorption fields because of the slow permeability and the wetness.

The land capability classification is IVe, and the range site is Clay Upland.

Px—Paxico silt loam, frequently flooded. This deep, nearly level, somewhat poorly drained soil is on flood plains. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, calcareous silt loam about 8 inches thick. The substratum extends to a depth of about 60 inches. It is calcareous, stratified, and mottled. The upper part is dark grayish brown, very dark grayish brown, and grayish brown silt loam, and the lower part is grayish brown fine sandy loam.

Included with this soil in mapping are small areas of Haynie and Sarpy soils. The well drained Haynie soils are on stream terraces above the Paxico soil. The excessively drained Sarpy soils are more sandy than the Paxico soil. They are in positions on the landscape similar to those of the Paxico soil. Included soils make up about 10 percent of the map unit.

Permeability is moderate in the Paxico soil. Runoff is slow. Available water capacity is high. Organic matter content is moderate, and natural fertility is medium. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is low throughout the soil. A seasonal high water table is at a depth of about 1.5 to 3.0 feet in winter and spring.

About one-third of the acreage is used for cultivated crops. The remainder is used as woodland. The soil is generally unsuited to cultivated crops because of the frequent flooding. Vegetation includes cottonwood, willow, hackberry, and sycamore trees and a few grasses. Restricting use during wet periods reduces surface compaction. Maintaining an adequate plant cover helps to control soil blowing.

This soil is well suited to trees. Seedling mortality and plant competition are moderate. The equipment limitation and the windthrow hazard are severe. Harvesting equipment can be used only during dry periods. Because the high water table restricts the root zone, trees commonly blow over before they reach a harvestable size. Tree seedlings and cuttings survive and grow well if competing plants are controlled. Thinning and removing undesirable trees, applying selective harvesting methods, and eliminating grazing are usually needed.

This soil is generally unsuited to building site development because of the flooding and the wetness.

The land capability classification is Vw. No range site is assigned.

Rb—Reading silt loam. This deep, nearly level, moderately well drained soil is on stream terraces along the Kansas River. It is subject to rare flooding. Individual areas are irregular in shape and range from 10 to 250 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 6 inches thick (fig. 10). The subsurface layer is very dark brown silt loam about 9 inches thick. The subsoil is firm silty clay loam about 21 inches thick. The upper part is very dark grayish brown, and the lower part is dark brown. The substratum extends to a depth of about 60 inches. It is mottled. The upper part is very dark grayish brown silty clay loam, the next part is dark brown silty clay, and the lower part is dark grayish brown and brown silty clay. In some places the clayey substratum is deeper than 40 inches. In other places free carbonates are in the substratum.

Included with this soil in mapping are small areas of the well drained Eudora soils. They are in positions on the landscape similar to those of the Reading soil. They make up about 10 percent of the map unit.

Permeability is moderately slow in the Reading soil. Runoff is slow. Organic matter content is moderate. Available water capacity and natural fertility are high. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate in the subsoil. A seasonal high water table is at a depth of about 3.5 to

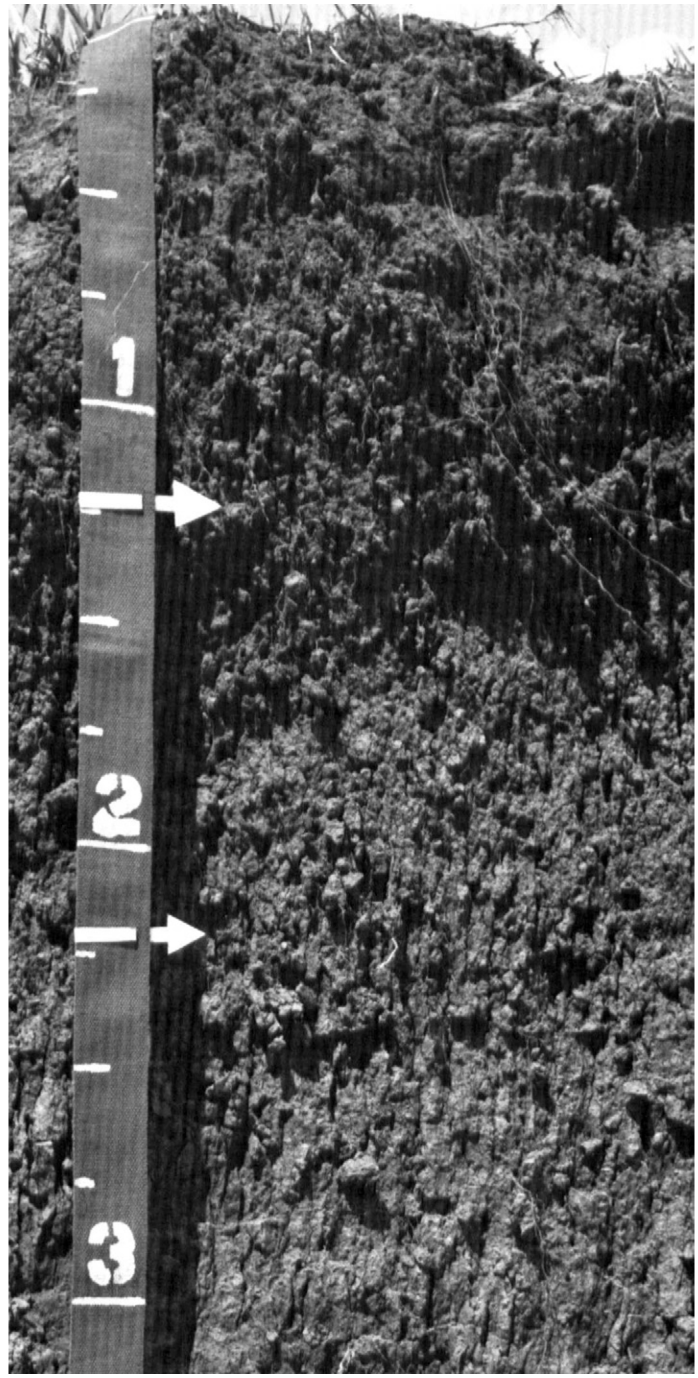

Figure 10.—Typical profile of Reading silt loam. Depth is marked in feet.

6.0 feet in winter and early spring.

All of the acreage is used for cultivated crops. This soil is well suited to corn, grain sorghum, soybeans, and wheat. Maintaining fertility is the main management concern. Returning crop residue to the soil and adding other organic material improve tilth and fertility, minimize surface crusting, and increase the rate of water infiltration.

Corn is the main irrigated crop. The main management concerns are using water efficiently and maintaining soil fertility. Leaving crop residue on the surface helps to maintain tilth and fertility. Controlling the rate of water application promotes the efficient use of water and energy.

This soil is generally unsuited to dwellings because of the flooding. Onsite inspection and knowledge of the history of flooding in a given area are needed when building sites are selected. Overcoming this hazard is difficult without major flood-control measures.

This soil is moderately well suited to sewage lagoons. Seepage and wetness are limitations. Sealing the lagoon helps to control seepage. The soil is generally unsuited to septic tank absorption fields because of the wetness and the moderately slow permeability.

The land capability classification is I, and the range site is Loamy Lowland.

Re—Reading silty clay loam. This deep, nearly level, well drained soil is on stream terraces. It is subject to rare flooding. Individual areas are irregular in shape and range from 30 to 150 acres in size.

Typically, the surface layer is very dark gray silty clay loam about 6 inches thick. The subsurface layer is very dark gray silty clay loam about 7 inches thick. The subsoil is firm silty clay loam about 32 inches thick. The upper part is very dark grayish brown, and the lower part is dark brown and mottled. The substratum to a depth of about 60 inches is dark brown, mottled silty clay loam.

Included with this soil in mapping are small areas of Chase and Ivan soils. The somewhat poorly drained Chase soils are more clayey in the subsoil than the Reading soil. Also, they are generally nearer the stream channels. The calcareous Ivan soils are more silty throughout than the Reading soil. They are adjacent to the stream channels. Included soils make up about 10 percent of the map unit.

Permeability is moderate in the Reading soil. Runoff is slow. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate in the subsoil.

Nearly all of the acreage is used for cultivated crops. This soil is well suited to corn, wheat, grain sorghum, soybeans, and alfalfa. The main management concerns are maintaining soil fertility and organic matter content. Returning crop residue to the soil and adding other organic material improve tilth and fertility, minimize crusting, and increase the rate of water infiltration. Crop rotations help to control weeds, plant diseases, and insect carry-over.

This soil is generally unsuited to dwellings because of the flooding. Onsite inspection and knowledge of the history of flooding in a given area are needed when building sites are selected. Overcoming this hazard is difficult without major flood-control measures.

This soil is only moderately well suited to septic tank absorption fields because of the moderate permeability in the subsoil. Increasing the size of the absorption field can improve the functioning of the septic tank system. The soil is only moderately well suited to sewage lagoons because of seepage. Sealing the lagoon helps to control seepage.

The land capability classification is I, and the range site is Loamy Lowland.

Sa—Sarpy loamy sand, frequently flooded. This deep, nearly level, excessively drained soil is on flood plains along the Kansas River. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, calcareous, loamy sand about 5 inches thick. The substratum is calcareous sand to a depth of about 60 inches. The upper part is brown, and the lower part is pale brown. In places the soil is mottled in the lower part.

Included with this soil in mapping are small areas of Eudora, Haynie, and Paxico soils. The silty Eudora soils are on terraces above the Sarpy soil. Haynie soils are in positions on the landscape similar to those of the Sarpy soil. They are less sandy than the Sarpy soil. The somewhat poorly drained Paxico soils are nearer the river channel, slightly below the Sarpy soil. Included soils make up about 10 percent of the map unit.

Permeability is rapid in the Sarpy soil. Runoff is slow. Available water capacity, organic matter content, and natural fertility are low. The surface layer is friable and can be easily tilled throughout a wide range in moisture content. The shrink-swell potential is low throughout the profile.

Most of the acreage is used as woodland. A few areas are used for cultivated crops. This soil is poorly suited to wheat and grain sorghum because of the hazards of flooding and soil blowing and the limitation of droughtiness. Reducing the number of tillage operations, planting winter cover crops, and applying a system of conservation tillage that leaves all or part of the crop residue on the surface help to control soil blowing.

This soil is poorly suited to range. Vegetation includes cottonwood trees and a few grasses. Low forage production and droughtiness are limitations, and soil blowing is a hazard. Maintaining an adequate plant cover helps to control soil blowing. Proper stocking rates, scheduled deferment and uniform distribution of grazing, and brush management help to keep the range in the best condition.

This soil is moderately well suited to trees. Seedling mortality is severe because of droughtiness and the sandy surface texture. Thinning and selective harvesting improve the stand.

This soil is generally unsuited to building site development because of the flooding.

The land capability classification is IVs, and the range site is Sandy Lowland.

Sc—Sarpy-Haynie complex, occasionally flooded. These deep, nearly level soils are on flood plains along the Kansas River. The excessively drained Sarpy soil is slightly mounded above the well drained Haynie soil. Individual areas are irregular in shape and range from 10 to 300 acres in size. They are about 45 percent Sarpy soil and 30 percent Haynie soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the Sarpy soil has a surface layer of dark brown loamy sand about 6 inches thick. The upper part of the substratum is brown sand. The next part is dark grayish brown and brown, calcareous, stratified silt loam. The lower part to a depth of about 60 inches is brown sand. In places the surface layer is thicker and darker.

Typically, the Haynie soil has a surface layer of very dark grayish brown and dark grayish brown, calcareous, fine sandy loam about 7 inches thick. The upper part of the substratum is dark grayish brown and pale brown, calcareous, stratified fine sandy loam. The lower part to a depth of about 60 inches is grayish brown and dark grayish brown, stratified silt loam.

Included with these soils in mapping are small areas of Eudora and Kimo soils. The silty Eudora soils and the clayey Kimo soils are on stream terraces. Included soils make up about 25 percent of the map unit.

Permeability is rapid in the Sarpy soil and moderate in the Haynie soil. Natural fertility is low in the Sarpy soil and medium in the Haynie soil. Available water capacity is low in the Sarpy soil and high in the Haynie soil. Organic matter content is low in the Sarpy soil and moderate in the Haynie soil. Runoff is slow on both soils. The surface layer is friable in both soils and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is low throughout both soils.

Nearly all of the acreage is used for cultivated crops. Some small areas are wooded. These soils are moderately well suited to corn, grain sorghum, soybeans, and alfalfa. Flooding and soil blowing are hazards on both soils if cultivated crops are grown. Droughtiness and the sandy surface texture are limitations in areas of the Sarpy soil. Crop yields are reduced in some years on both soils because of the flooding. In other years, however, the extra moisture may increase yields. Overcoming the hazard of flooding is difficult without major flood-control measures. Reducing the number of tillage operations, planting winter cover crops, and applying a system of conservation tillage that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve tilth and fertility, minimize surface crusting, and increase the rate of water infiltration.

The Sarpy soil is moderately well suited to trees, and the Haynie soil is well suited. Seedling mortality is severe in areas of the Sarpy soil because of the droughtiness and the sandy surface texture. Thinning and selective harvesting improve the stand.

These soils are generally unsuited to building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is IIIw. The range site assigned to the Sarpy soil is Sandy Lowland, and the one assigned to the Haynie soil is Loamy Lowland.

Tz—Tuttle channery silty clay loam, 20 to 60 percent slopes, stony. This deep, steep and very steep, somewhat excessively drained soil is on breaks and side slopes. Numerous limestone rocks are scattered on the surface. The rocks are irregular in shape and range from 1 to 5 feet in diameter. They cover from 1 to 2 percent of the surface and are 2 to 6 feet apart. Individual areas of this soil are long and narrow and range from 20 to 500 acres in size.

Typically, the surface layer is very dark gray, calcareous channery silty clay loam about 10 inches

Figure 11.—An area of Tuttle channery silty clay loam, 20 to 60 percent slopes, stony, in the background. Chinkapin oak is the dominant vegetation.

thick. The subsoil is about 35 inches thick. It is firm. The upper part is very dark gray, calcareous channery silty clay, and the lower part is grayish brown, calcareous channery silty clay loam. The substratum is olive, calcareous silty clay about 9 inches thick. Calcareous shale bedrock is at a depth of about 54 inches. In places the surface layer is noncalcareous.

Included with this soil in mapping are small areas of Clime and Sogn soils and rock outcrops. The moderately deep Clime soils are in positions on the landscape similar to those of the Tuttle soil. The shallow Sogn soils are on breaks above the Tuttle soil and above the rock outcrops. The rock outcrops occur as narrow bands on the contour of the slopes. Included areas make up about 15 percent of the map unit.

Permeability is slow in the Tuttle soil. Runoff is very rapid. Available water capacity and organic matter content are moderate. Natural fertility is medium. The shrink-swell potential is moderate in the subsoil. Root development is restricted by the bedrock at a depth of about 54 inches.

Nearly all of the acreage is woodland. Because of a severe hazard of erosion, the slope, and the many stones on the surface, this soil is unsuited to cultivated crops. It is better suited to woodland. The native vegetation is dominantly chinkapin oak (fig. 11). Associated species include a wide variety of other hardwoods. A few grasses and numerous shrubs and vines make up the understory.

This soil is only moderately well suited to trees because of the hazard of erosion, the equipment limitation, seedling mortality, and plant competition. Thinning and selective harvesting are usually needed. Because of the slope, the use of logging equipment is restricted and erosion is a hazard along logging trails.

This soil is generally unsuited to building site development because of the slope.

The land capability classification is VIIe. No range site is assigned.

Wb—Wabash silty clay, occasionally flooded. This deep, nearly level, very poorly drained soil is on flood plains. Individual areas are irregular in shape and range from 10 to 1,000 acres in size.

Typically, the surface layer is black silty clay about 6 inches thick. The subsurface layer is black, mottled silty clay about 16 inches thick. The subsoil extends to a depth of more than 60 inches. It is extremely firm, mottled clay. The upper part is very dark gray, and the lower part is dark gray. In some places the surface soil is thicker and less clayey. In other places the soil is calcareous.

Included with this soil in mapping are small areas of Chase, Ivan, and Reading soils. The somewhat poorly drained Chase soils are on stream terraces. The well drained, calcareous Ivan soils are along the stream channels. They are silty. The well drained Reading soils are on stream terraces. Included soils make up about 15 percent of the map unit.

Permeability is very slow in the Wabash soil. Runoff also is very slow. Available water capacity and organic matter content are moderate. Natural fertility is high. The surface layer is very firm, and tilth is poor. The shrink-swell potential is very high in the subsoil. A seasonal high water table is at the surface to 1 foot below in winter and spring.

Nearly all of the acreage is used for cultivated crops. This soil is moderately well suited to grain sorghum, soybeans, and wheat. Flooding is a hazard if cultivated crops are grown. Wetness and droughtiness are limitations. Crop yields are reduced in some years because of the flooding. In years of above average rainfall, wetness and flooding delay planting and harvesting and cause some crop damage. Overcoming the hazard of flooding is difficult without major flood-control measures. If the soil is tilled when it is too wet, surface compaction is a problem. It can be minimized, however, by timely tillage. The clayey surface layer and subsoil resist the movement of air and water and root penetration and slowly release water to plants. Returning crop residue to the surface and adding other organic material improve tilth and fertility, minimize surface crusting, and increase the rate of water infiltration.

This soil is suited to trees, but only a small acreage supports native trees. Because of the wetness, the equipment limitation, and plant competition, seedling mortality is severe. The trees should be harvested in fall and winter when the amount of precipitation is lowest. Tree seedlings and cuttings survive and grow well only if competing plants are controlled. Also, site preparation and controlled burning, spraying, or cutting help to control undesirable plants.

This soil is generally unsuited to building site development because of the flooding, the wetness, and the high shrink-swell potential.

The land capability classification is IIIw, and the range site is Clay Lowland.

We—Wamego silty clay loam, 3 to 7 percent slopes. This moderately deep, moderately sloping, well drained soil is on narrow ridgetops and side slopes. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is very dark gray silty clay loam about 8 inches thick. The subsurface layer is dark brown and very dark grayish brown silty clay loam about 6 inches thick. The subsoil is mottled, firm silty clay loam about 16 inches thick. The upper part is dark grayish brown and yellowish brown. The lower part is yellowish brown and grayish brown and contains few fine sandstone and shale fragments. Shale bedrock is at a depth of about 30 inches. In some places the depth to bedrock is less than 20 inches, and in other places it is more than 40 inches. In some areas the subsoil is less clayey. In other areas the soil is calcareous.

Included with this soil in mapping are small areas of Clime, Elmont, and Martin soils and limestone, sandstone, and shale outcrops. The calcareous Clime soils are on side slopes above the Wamego soil. The deep Elmont soils are on foot slopes below the Wamego soil. The deep Martin soils are generally on side slopes above the Wamego soil. Rock outcrops occur as narrow bands on the contour of the slopes. Included areas make up about 25 percent of the map unit.

Permeability is slow in the Wamego soil. Runoff is medium. Available water capacity is low. Organic matter content is moderate, and natural fertility is medium. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate in the subsoil. Root development is restricted by the bedrock at a depth of about 30 inches.

Most of the acreage is used for range. The remainder is used for cultivated crops or tame grass pasture. The main crops are wheat and grain sorghum. This soil is poorly suited to cultivated crops because of the hazard of erosion. Reducing the number of tillage operations, terracing, establishing grassed waterways, and farming on the contour help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve fertility and tilth, increase the rate of water infiltration, and reduce the runoff rate.

This soil is better suited to range than to cultivated crops. The native vegetation is dominantly big bluestem, little bluestem, and indiangrass. Overgrazing depletes the plant cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and by weeds. Proper stocking rates, rotation grazing, and timely deferment of grazing help to keep the range in good condition. Trees and brush have invaded in some areas. As a result, brush control is needed to increase forage production. Controlled burning in late spring helps to remove the woody plants. Properly applied chemical sprays and selective cutting also help to remove these plants. Applications of fertilizer and timely mowing of tame grass pasture increase forage production.

This soil is only moderately well suited to dwellings because of the shrink-swell potential. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling.

Because of the depth to bedrock and the slow permeability, this soil is poorly suited to septic tank absorption fields. It is poorly suited to sewage lagoons because of the depth to bedrock.

The land capability classification is IVe, and the range site is Loamy Upland.

Wf—Wamego silty clay loam, 7 to 15 percent slopes. This moderately deep, strongly sloping, well drained soil is on side slopes. Individual areas are irregular in shape and range from 50 to 900 acres in size.

Typically, the surface layer is very dark gray silty clay loam about 7 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 4 inches thick. The subsoil is mottled, firm silty clay loam about 14 inches thick. The upper part is brown and dark brown, and the lower part is dark grayish brown and brown. Shale bedrock is at a depth of about 25 inches. In some places the depth to bedrock is less than 20 inches, and in other places it is more than 40 inches. In some areas the soil is less clayey. In other areas it is calcareous.

Included with this soil in mapping are small areas of Clime, Elmont, Martin, and Sogn soils and limestone, sandstone, and shale outcrops. The calcareous Clime soils are on side slopes above the Wamego soil. The deep Elmont soils are on foot slopes, generally below the Wamego soil. The deep Martin soils are on side slopes, generally above the Wamego soil. The shallow Sogn soils are on breaks above the Wamego soil. Rock outcrops occur as narrow bands on the contour of the slopes. Included areas make up about 25 percent of the map unit.

Permeability is slow in the Wamego soil. Runoff is rapid. Available water capacity is low. Organic matter content is moderate, and natural fertility is medium. The shrink-swell potential is moderate in the subsoil. Root development is restricted by the bedrock at a depth of about 25 inches.

Nearly all of the acreage is used as range. A few small areas are cultivated. Some areas are in tame grass pasture, and other areas are wooded. Because of a severe hazard of erosion, this map unit is generally unsuited to cultivated crops. It is better suited to range. The native vegetation is dominantly big bluestem, little bluestem, and indiangrass. Overgrazing depletes the plant cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and by weeds. Proper stocking rates, rotation grazing, and timely deferment of grazing help to keep the range in good condition. Applications of fertilizer and timely mowing of tame grass pasture increase plant vigor, quality, and quantity. Trees and brush have invaded in some areas. As a result, brush control is needed to increase forage production. Controlled burning in late spring helps to remove the woody plants. Properly applied chemical sprays and selective cutting also help to remove these plants.

This soil is only moderately well suited to dwellings because of the moderate shrink-swell potential and the slope. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling. Some land shaping can compensate for the slope. Also, the less sloping areas can be selected.

Because of the depth to bedrock and the slow permeability, this soil is poorly suited to septic tank absorption fields and sewage lagoons.

The land capability classification is VIe, and the range site is Loamy Upland.

Wy—Wymore silty clay loam, 2 to 6 percent slopes. This deep, gently sloping and moderately sloping, moderately well drained soil is on ridgetops and the upper side slopes. Individual areas are irregular in shape and range from 20 to 300 acres in size.

Typically, the surface layer is very dark brown silty clay loam about 8 inches thick. The subsoil is very firm, mottled silty clay about 32 inches thick. The upper part is very dark grayish brown, the middle part is dark brown and brown, and the lower part is grayish brown. The substratum to a depth of about 60 inches is mottled silty clay loam. The upper part is grayish brown and light brownish gray, and the lower part is grayish brown. In some places the surface layer is silty clay. In other places the substratum is clay loam or clay and contains pebbles. In places the dark colors extend to a depth of more than 20 inches.

Permeability is slow in the Wymore soil. Runoff is medium. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is firm, and tilth is fair. A perched seasonal high water table is at a depth of about 1 to 3 feet in spring. The shrink-swell potential is high in the subsoil.

Nearly all of the acreage is used for cultivated crops. This soil is moderately well suited to wheat, grain sorghum, soybeans, and alfalfa. Crop yields may be reduced by wetness. They may also be reduced during long periods of drought because the clayey subsoil does not readily release water to plants. Water erosion is a hazard if cultivated crops are grown. Reducing the number of tillage operations, terracing, farming on the contour, establishing grassed waterways, and applying a system of conservation tillage that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve tilth and fertility, minimize crusting, and increase the rate of water infiltration.

This soil is suited to tame and native grasses for hay or pasture. The native vegetation is dominantly big bluestem, little bluestem, and switchgrass. If the range is overgrazed, these grasses are replaced by less desirable grasses and by weeds, such as tall dropseed, sideoats grama, and western ragweed. Grazing when the soil is too wet causes surface compaction. Proper stocking rates, restricted use during wet periods, and timely deferment of grazing help to keep the range in good condition. Applications of fertilizer are generally needed to improve the vigor, quality, and quantity of tame grasses. Early mowing of these grasses for hay allows the plants to recover.

This soil is poorly suited to dwellings. The shrink-swell potential and the wetness are limitations. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by wetness and by shrinking and swelling.

This soil is only moderately well suited to sewage lagoons because of the slope. Land shaping can compensate for the slope. The soil is generally unsuited to septic tank absorption fields because of the wetness and the slow permeability.

The land capability classification is IIIe, and the range site is Clay Upland.

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 supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 250,000 acres in the county, or nearly 50 percent of the total acreage, meets the soil requirements for prime farmland. Most areas of this land are in the Irwin-Martin-Ladysmith, Eudora-Haynie-Wabash, Ivan-Reading-Chase, Martin-Wamego-Elmont, and Pawnee-Martin-Wymore associations, which are described under the heading "General Soil Map Units." About 150,000 acres of prime farmland is used for crops. The chief crops are winter wheat, grain sorghum, soybeans, and alfalfa hay. Corn also is grown on the bottom land.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table qualify for prime farmland only in areas where this limitation has been overcome by drainage measures. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

Use and Management of the Soils

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

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

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the 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 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

Jerry B. Lee, 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.

About 114,000 acres in Wabaunsee County, or 22 percent of the total acreage, is used for cultivated crops. During the period 1974 to 1984, wheat was grown on about 35 percent of the cropland, grain sorghum on 30 percent, and corn, alfalfa, soybeans, and oats on 35 percent *(3)*.

Crop production can be increased on most farms by applying the latest technology. This soil survey can facilitate the application of such technology. The main concerns in managing the soils in Wabaunsee County are controlling water erosion and maintaining fertility and tilth.

Water erosion is the major hazard on about 70 percent of the cropland in the county. It occurs mainly on soils that have a slope of more than 1 or 2 percent. Examples are Clime, Elmont, Gymer, Irwin, Labette, Morrill, Martin, Pawnee, Wamego, and Wymore soils.

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. Loss of the surface layer is especially damaging on soils that have a clayey subsoil, such as Clime, Gymer, Irwin, Labette, Martin, Pawnee, Wamego, and Wymore soils. Secondly, erosion results in the pollution of streams by sediments, nutrients, and pesticides. Control of erosion minimizes this pollution and improves the quality of water.

Erosion-control measures provide a protective cover, reduce the runoff rate, and increase the rate of water infiltration. A cropping system that keeps a plant cover on the surface for extended periods helps to control erosion and preserves the productive capacity of the soils.

Conservation tillage is effective in controlling water erosion in Wabaunsee County. A system of conservation tillage leaves the stubble of crops or a protective amount of crop residue on the surface before and during the preparation of a seedbed and during at least part of the growing period of the succeeding crop. The conservation tillage systems used in the county are no-till, mulch-till, and reduced till. Where a no-till system is applied, the seed is planted into undisturbed soil and all residue from the preceding crop is left on the surface. Where mulch-till or reduced till is applied, a seedbed is prepared with stubble mulch plows, chisels, field cultivator disks, or blades that leave crop residue on the surface.

Terraces, diversions, grassed waterways, and contour farming are generally needed in combination with conservation tillage on soils that have a slope of more than 2 percent. They also are needed in areas where soils that have a slope of more than 1 percent are not protected by conservation tillage. Terraces and diversions shorten the length of slopes and thus reduce the runoff rate and the susceptibility to erosion. They are most practical on deep, well drained soils that have uniform slopes. Contour farming should generally be used in combination with terraces. It is best suited to soils that have smooth, uniform slopes and are suitable for terracing.

Organic matter is a storehouse of available plant nutrients. It increases the rate of water intake, minimizes surface crusting, helps to control erosion, and improves tilth. Most of the soils in the county that are used for crops have a surface layer of silt loam. A surface crust forms during periods of heavy rainfall. When dry, the crusted surface is nearly impervious to water. As a result, the runoff rate is increased. Regularly adding organic material and leaving crop residue on the surface minimize surface crusting, increase the rate of water infiltration, and reduce the runoff rate and the hazard of erosion.

Plants on most of the arable soils in the county respond well to applications of nitrate and phosphate fertilizer. On all soils the amount of fertilizer to be applied should be based on the results of soil tests, on the needs of the crop, on the expected level of yields, and on the experience of farmers. The Cooperative Extension Service can help to determine the kind and amount of fertilizer to be applied.

Information about the design of erosion-control practices is available in the local office of the Soil Conservation Service. The latest information about growing crops can be obtained from the Cooperative Extension Service or the Soil Conservation Service.

About 4 percent of the acreage in Wabaunsee County is pastured. Cool-season grasses, such as smooth bromegrass, are dominant in the pastured areas throughout the county. The main concerns in managing these areas are maintaining or improving the quality and quantity of forage, protecting the soil, and conserving water.

Proper stocking rates help to maintain a good stand of grasses. The number of livestock should be adjusted to the expected level of yields. Delaying grazing in the spring until the soil is dry and firm helps to prevent the damage caused by trampling and compaction. Bromegrass should not be grazed during its midsummer dormancy. Rotation grazing helps to prevent depletion of a pasture by allowing the grasses to recover after periods of grazing. Maintaining an adequate ground cover during the periods of grazing helps to control erosion. Providing adequate supplies of water and salt at a variety of locations results in a uniform distribution of grazing. Applying the proper kinds and amounts of fertilizer increases forage production. Mowing a pasture that has been grazed unevenly or has an excess of forage and spraying with herbicides help to control invading trees, brush, and broad-leaved weeds. The herbicide should be labeled for that purpose and approved by the state.

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 land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations also are 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 ensures 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 the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

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

Capability classes, the broadest groups, are designated by 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 hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c,* used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

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

The capability classification of each map unit is given in the section "Detailed Soil Map Units," in the yields table, and in the section "Interpretive Groups."

Rangeland

Mike Meurisse, range conservationist, Soil Conservation Service, helped prepare this section.

About 334,100 acres in Wabaunsee County, or 65 percent of the total acreage, is range. Livestock, principally cattle, account for almost 60 percent of the value of agricultural products in the county. A substantial portion of the range is used for yearling enterprises.

Some livestock producers extend the grazing season with cool-season bromegrass or fescue pastures. Many, particularly those who operate cow-calf enterprises, also supplement the forage produced on the range with crop residue from grain sorghum or with sudangrass. During the winter, hay and protein concentrates are usually fed to the livestock.

Soils strongly influence the potential natural plant community in any given area within the county. The soils and climate of the county generally favor a natural plant community of tall prairie grasses dominated by bluestems, indiangrass, and switchgrass. Some of the steep, shallow soils, however, are capable of supporting only the plants similar to the mixed prairie grasses of central Kansas.

Naturally occurring fires played a major role in the development of the plant communities in the county. In areas where fire has been prevented, the productivity of the range has been reduced by brush invasion. Controlled burning is used extensively as a management tool in Wabaunsee County to control brush invasion, to improve the distribution of grazing, and to increase productivity.

While much of the rangeland in the county has been well managed, forage production has been reduced in some areas by overgrazing. Proper grazing use and an even distribution of grazing help to keep the range in good condition. These measures also improve the range when used in combination with timely deferment of grazing, a planned grazing system, brush management, and reseeding.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 7 shows, for nearly all the soils, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as rangeland or are suited to rangeland are listed. An explanation of the column headings in table 7 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

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

Dry weight is the total annual yield per acre of air-dry vegetation. Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—are listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Woodland Management and Productivity

Keith A. Ticknor, forester, Soil Conservation Service, helped prepare this section.

About 20,600 acres in Wabaunsee County, or 4 percent of the total acreage, is forested. The woodland occurs as irregular tracts and narrow bands along streams and rivers, as strips in upland drainageways, and as irregular tracts on steep soils in the uplands.

The woodland is divided into three main forest cover types—hackberry-American elm-green ash, cottonwood, and chinkapin oak. The hackberry-American elm-green ash type is in areas of the Ivan-Reading-Chase association on bottom land and in upland drainageways. This association is described under the heading "General Soil Map Units." Boxelder, mulberry, bur oak, black walnut, slippery elm, silver maple, Kentucky coffeetree, American sycamore, honeylocust, Osageorange, eastern cottonwood, American basswood, black willow, peachleaf willow, sandbar willow, Carolina willow, chinkapin oak, bitternut hickory, Ohio buckeye, common chokecherry, indigobush, buckbrush, American elder, gooseberry, burning bush, and American plum are among the associated species. Numerous vines, such as bristly greenbrier, American bittersweet, Virginia creeper, common moonseed, and riverbank grape, also are evident.

The cottonwood forest cover type is in areas of the Eudora-Haynie-Wabash association on bottom land along the Kansas River. Mulberry, willows, silver maple, boxelder, American sycamore, northern catalpa, hackberry, American elm, buckbrush, roughleaf dogwood, indigobush, and eastern redbud are among the associated species. Numerous vines also are evident.

The chinkapin oak forest cover type is in areas of the Clime-Sogn-Martin association on uplands. Green ash, hackberry, eastern redbud, pawpaw, Kentucky coffeetree, American elm, American basswood, eastern redcedar, Ohio buckeye, bitternut hickory, black walnut, bur oak, roughleaf dogwood, buckbrush, common pricklyash, common chokecherry, American plum, and gooseberry are among the associated species. Vines, such as blackberry, greenbrier, grape, and moonseed, also are evident.

Fragrant sumac, New Jersey tea, roughleaf dogwood, American plum, common chokecherry, and eastern redbud grow in steep upland areas that include rock outcrop.

Many of the trees, especially those on bottom land, can be used for commercial wood products. Many of the soils have good potential for Christmas trees and for the trees used in the production of veneer, sawtimber, and other wood products. Only a small part of the woodland, however, is managed for commercial wood production. Most of the wooded areas are privately owned tracts making up only a small acreage of the farms. Most of the acreage is cropland that is unlikely to be converted to commercial woodland. The soils on bottom land produce high-value hardwoods within a short period. In contrast, upland soils produce low-value trees over a long period.

Table 8 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; and *F*, a high content of rock fragments in the soil. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, and F.

In table 8, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, fire lanes, and log-handling areas. Forests that have been burned or overgrazed also are subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment or season of use is not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to

3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Plant competition ratings indicate the degree to which undesirable species are expected to invade and grow when openings are made in the tree canopy. The main factors that affect plant competition are the depth to the water table and the available water capacity. A rating of *slight* indicates that competition from undesirable plants is not likely to prevent natural regeneration or suppress the more desirable species. Planted seedlings can become established without undue competition. A rating of *moderate* indicates that competition may delay the establishment of desirable species. Competition may hamper stand development, but it will not prevent the eventual development of fully stocked stands. A rating of *severe* indicates that competition can be expected to prevent regeneration unless precautionary measures are applied.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *productivity class*. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *productivity class*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic meters per hectare per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil is the indicator species for that soil. It is the dominant species on the soil and the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Windbreaks and Environmental Plantings

Keith A. Ticknor, forester, Soil Conservation Service, helped prepare this section.

Trees grow on most of the farmsteads in Wabaunsee County. They were planted at various times by the landowners. Some of these are windbreaks, but most are environmental or ornamental plantings. Eastern redcedar and Siberian elm are the most common species in the windbreaks, and Austrian pine, green ash, hackberry, black walnut, honeysuckle, and lilac are the most common species used as environmental plantings. Ornamental plantings include green ash, honeylocust, Austrian pine, ponderosa pine, Scotch pine, lilac, and American elm.

Many windbreaks and environmental plantings are planted each year. Tree planting is a continual need because old trees pass maturity and deteriorate, because some trees are destroyed by insects, disease, or storms, and because new plantings are needed on expanding farmsteads.

Many field windbreaks are established throughout the county. They generally are hedgerows of Osageorange. They were planted as property lines and field boundaries, as living fences, and as a source of wood for posts. Many field windbreaks are being removed because fields are being enlarged.

In order for windbreaks and environmental plantings to fulfill their intended purpose, the soils on the site should be suited to the trees or shrubs selected for planting. Permeability, available water capacity, fertility, soil depth, and texture greatly affect the growth rate.

Trees and shrubs can be easily established in the county. The survival rate may be restricted, however, mainly by competition from weeds and grasses. The main management needs are proper site preparation before the trees and shrubs are planted and measures that control the competing weeds and grasses after the trees and shrubs are planted. Supplemental watering is needed during dry periods.

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 9 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 9 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 Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

Robert J. Higgins, biologist, Soil Conservation Service, helped prepare this section.

Wabaunsee County has several areas of scenic, geologic, and historic interest. Most of the county is in the Bluestem Hills major land resource area, which is characterized by flat-topped hills; limestone rock outcrops; long, steep slopes; and beautiful valleys covered with grasses. The Kansas River and farm ponds and streams on privately owned land provide opportunities for water sports.

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation also are 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 10, 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 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

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.

Wildlife Habitat

Robert J. Higgins, biologist, Soil Conservation Service, helped prepare this section.

The primary game species in Wabaunsee County are bobwhite quail, mourning dove, prairie chicken, cottontail rabbit, fox squirrel, white-tailed deer, and waterfowl. Wild turkey also are hunted to a limited degree.

Nongame species are numerous because of the diverse habitat types in the county. Cropland, woodland, and rangeland are intermixed throughout the county. This intermixture creates the desirable edge effect suitable for a variety of wildlife species. Creating additional fringe areas generally can increase the wildlife population. The naturally wooded watercourses within the county provide permanent habitat and travel lanes for many species.

Furbearers are common along many of the streams. They are trapped on a limited basis.

Farm ponds, Lake Wabaunsee, Alma City Lake, Harveyville City Lake, Mill Creek, and the Kansas River provide good or excellent opportunities for fishing. The species commonly caught are largemouth bass, bluegill, crappie, carp, walleye, channel catfish, and flathead catfish.

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 11, 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, grain sorghum, soybeans, wheat, oats, and barley.

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

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

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 hardwoods and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, cottonwood, sycamore, elm, hackberry, black walnut, willow, ash, hickory, and mulberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian olive, autumn olive, plum, fragrant sumac, and crabapple.

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 red cedar, pine, and spruce.

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 gooseberry, dogwood, blackberry, buckbrush, prairie rose, and sumac.

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, cattail, prairie cordgrass, buttonbush, indigobush, 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 shallow areas of ponds and lakes.

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

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

Habitat for 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 owls, hawks, wild turkey, thrushes, woodpeckers, squirrels, opossum, raccoon, and white-tailed 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, red-winged blackbirds, muskrat, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include coyotes, badgers, cottontail rabbits, hawks, prairie chickens, meadowlark, and killdeer.

Technical assistance in planning wildlife areas and in determining the vegetation suitable for planting can be obtained from the Soil Conservation Service office. Additional information can be obtained from the Kansas Fish and Game Commission and from the Cooperative Extension Service.

Engineering

John A. Eberwein, 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 need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the 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 12 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. 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, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. The 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.

Sanitary Facilities

Table 13 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 13 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

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

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to 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 13 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability 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 13 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

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

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

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

Construction Materials

Table 14 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, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. These soils 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 14, 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 15 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

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

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

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

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

Engineering Index Properties

Table 16 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 (fig. 12). "Loam," for example, is soil that is

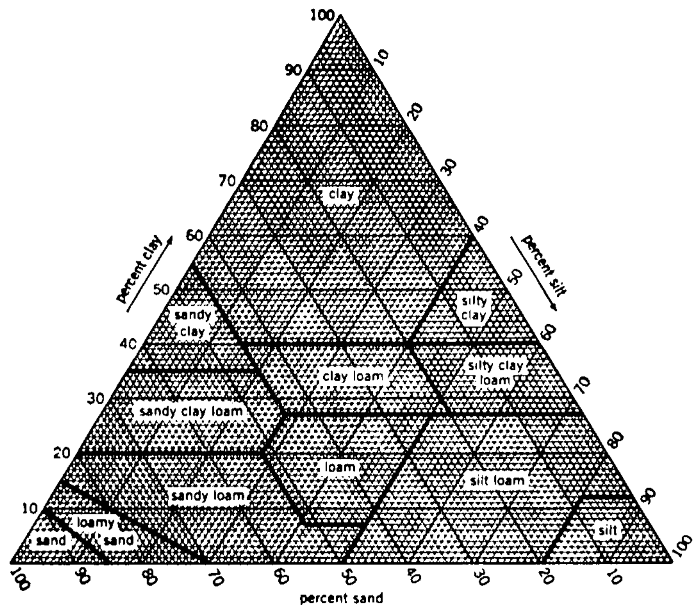

Figure 12.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system *(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, CL-ML.

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

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

Rock fragments 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.

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

Physical and Chemical Properties

Table 17 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 content of clay in 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 ⅓ 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.

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

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

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

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

The 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 soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Coarse sands, 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 coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous 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 soil blowing are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

8. Soils that are not subject to soil blowing because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 17, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

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

Soil and Water Features

Table 18 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 infiltration 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, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 18 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less 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.

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 18 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 18. Only saturated zones within a depth of about 6 feet are indicated.

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

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

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing.

Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion also is expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(5)*. 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 19 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

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 Ustoll (*Ust*, meaning intermittent water, plus *oll*, from Mollisol).

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 Argiustolls (*Argi*, meaning argillic horizon, plus *ustoll*, the suborder of the Mollisols that has an ustic moisture regime).

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 *Pachic* identifies the subgroup that has a thicker surface layer than is typical for the great group. An example is Pachic Argiustolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine, mixed, mesic Pachic Argiustolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual (4)*. Many of the technical terms used in the descriptions are defined in *Soil Taxonomy (5)*. Unless otherwise stated, colors in the descriptions are for moist 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."

Chase Series

The Chase series consists of deep, somewhat poorly drained, slowly permeable soils on stream terraces. These soils formed in clayey alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Chase silty clay loam, 500 feet west and 600 feet north of the southeast corner of sec. 23, T. 11 S., R. 11 E.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable, hard; few fine and medium roots; medium acid; clear smooth boundary.

A—7 to 12 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; firm, hard; few fine roots; medium acid; clear smooth boundary.

BA—12 to 20 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; very firm, very hard; few fine roots; slightly acid; gradual smooth boundary.

Bt1—20 to 38 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; common fine faint dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; very firm, very hard; few fine roots; common faint clay films along root channels and on faces of peds; slightly acid; gradual smooth boundary.

Bt2—38 to 42 inches; dark gray (10YR 4/1) clay, gray (10YR 5/1) dry; common medium faint dark yellowish brown (10YR 4/4) mottles; weak medium blocky structure; extremely firm, extremely hard; very few fine roots; common faint clay films on faces of peds; few fine concretions of lime; neutral; gradual smooth boundary.

Bt3—42 to 56 inches; dark grayish brown (10YR 4/2) clay, grayish brown (10YR 5/2) dry; common medium distinct dark yellowish brown (10YR 4/4 and 4/6) mottles; weak medium blocky structure; extremely firm, extremely hard; common faint clay films on faces of peds; few fine concretions of lime; mildly alkaline; gradual smooth boundary.

BC—56 to 60 inches; grayish brown (10YR 5/2) silty clay, light brownish gray (10YR 6/2) dry; common medium distinct dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; very firm, very hard; few concretions and threads of lime; mildly alkaline.

The mollic epipedon is more than 36 inches thick. The A horizon has value of 2 or 3 (3 to 5 dry) and chroma of 1 or 2. It is typically silty clay loam, but in some pedons it is silt loam. It ranges from medium acid to neutral. The Bt horizon has hue of 10YR or 2.5Y, value of 2 to 5 (4 to 6 dry), and chroma of 1 or 2. It is silty clay, silty clay loam, or clay. It ranges from medium acid to mildly alkaline.

Clime Series

The Clime series consists of moderately deep, well drained, slowly permeable soils on uplands (fig. 13). These soils formed in material weathered from calcareous, clayey shale. Slopes range from 3 to 40 percent.

Typical pedon of Clime silty clay loam, in an area of Clime-Sogn silty clay loams, 5 to 20 percent slopes; 900 feet west and 2,700 feet north of the southeast corner of sec. 35, T. 12 S., R. 9 E.

A—0 to 6 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium granular structure; friable, slightly hard; many fine and medium roots; few chert fragments; slight effervescence; mildly alkaline; clear smooth boundary.

AB—6 to 13 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; firm, hard; common fine roots; few chert fragments less than 1 inch in diameter; slight effervescence; mildly alkaline; clear smooth boundary.

Bw—13 to 26 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; moderate medium subangular blocky structure; very firm, very hard; few fine roots; few chert fragments less than ½ inch in diameter; strong effervescence; moderately alkaline; gradual smooth boundary.

BC—26 to 30 inches; dark grayish brown (2.5Y 4/2) silty clay loam, grayish brown (2.5Y 5/2) dry; weak medium subangular blocky structure; firm, hard; few fine roots; about 10 percent shale fragments less than ½ inch in diameter; strong effervescence; moderately alkaline; gradual smooth boundary.

C—30 to 37 inches; dark grayish brown (2.5Y 4/2) silty clay loam, light brownish gray (2.5Y 6/2) dry; massive; firm, hard; few fine roots; about 10 percent weathered shale fragments less than ½ inch in diameter; strong effervescence; moderately alkaline; clear smooth boundary.

Cr—37 inches; calcareous, clayey shale.

The depth to shale ranges from 20 to 40 inches. The mollic epipedon is 7 to 20 inches thick. The depth to

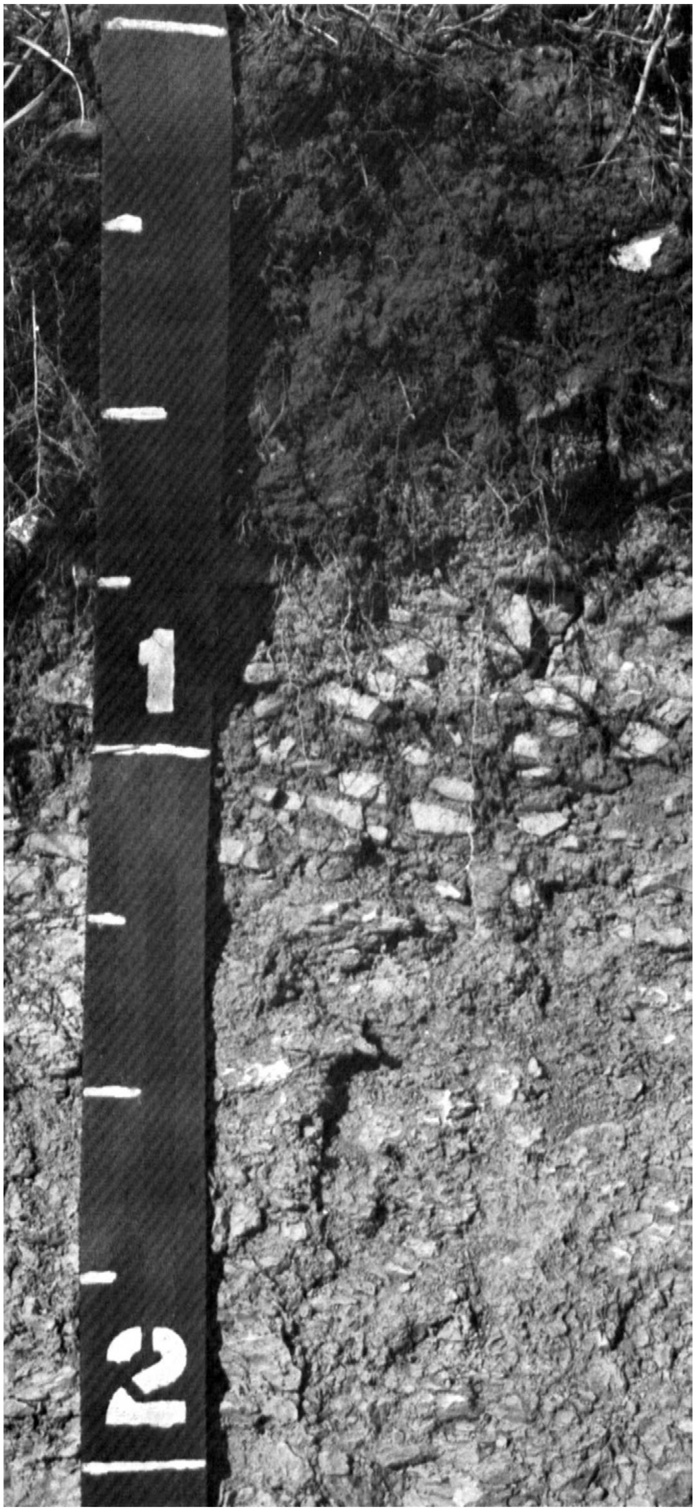

Figure 13.—Typical profile of a Clime silty clay loam. Depth is marked in feet.

free carbonates ranges from 0 to 10 inches. The soils typically are mildly alkaline or moderately alkaline throughout. In some pedons, however, they are neutral in the upper 10 inches. Some pedons have mottles in the C horizon.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3 (3 to 5 dry), and chroma of 1 or 2. The content of limestone fragments 3 inches to 3 feet in diameter ranges from 0 to 15 percent in this horizon.

The Bw horizon has hue of 10YR or 2.5Y, value of 3 to 6 (4 to 7 dry), and chroma of 1 to 4. It is silty clay, clay, or silty clay loam. The content of shale fragments less than 3 inches in diameter ranges from 0 to 10 percent in this horizon.

The C horizon has hue of 10YR to 5Y, value of 4 to 6 (5 to 7 dry), and chroma of 2 to 4. It is clay, silty clay, or silty clay loam. The content of shale fragments in this horizon is less than 35 percent.

Elmont Series

The Elmont series consists of deep, well drained, moderately slowly permeable soils on uplands. These soils formed in material weathered from interbedded sandstone and noncalcareous, micaceous, silty shale. Slopes range from 3 to 7 percent.

Typical pedon of Elmont silt loam, 3 to 7 percent slopes, 2,000 feet east and 300 feet north of the southwest corner of sec. 16, T. 11 S., R. 13 E.

A1—0 to 12 inches; black (10YR 2/1) silt loam, very dark grayish brown (10YR 3/2) dry; moderate fine granular structure; friable, slightly hard; many fine and medium roots; few sand grains; neutral; clear smooth boundary.

A2—12 to 19 inches; black (10YR 2/1) and dark brown (10YR 3/3) silt loam, dark grayish brown (10YR 4/2) and brown (10YR 4/3) dry; moderate fine granular structure; friable, slightly hard; many fine and medium roots; few sand grains; neutral; clear smooth boundary.

BA—19 to 24 inches; dark brown (10YR 3/3 and 7.5YR 4/4) silty clay loam, brown (10YR 4/3 and 7.5YR 5/4) dry; moderate fine subangular blocky structure; firm, hard; many fine and medium roots; few sand grains; neutral; clear smooth boundary.

Bt1—24 to 32 inches; dark yellowish brown (10YR 4/4) silty clay loam, brown (7.5YR 5/4) dry; common medium prominent yellowish red (5YR 4/6) mottles; moderate medium subangular blocky structure; firm, very hard; common fine roots; common faint clay films on faces of peds; few sandstone fragments less than 1 inch long; few fine black rounded concretions; neutral; gradual smooth boundary.

Bt2—32 to 50 inches; dark yellowish brown (10YR 4/4) silty clay loam, light yellowish brown (10YR 6/4) dry; many medium prominent yellowish red (5YR 4/6) mottles; moderate medium subangular blocky structure; firm, very hard; common fine roots; common faint clay films on faces of peds; few sandstone fragments less than 1 inch long; few black stains and rounded concretions; neutral; clear smooth boundary.

BC—50 to 57 inches; brownish yellow (10YR 6/6) and pale brown (10YR 6/3) silty clay loam, pale brown (10YR 6/3) and very pale brown (10YR 7/4) dry; many medium distinct strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; firm, hard; few sandstone fragments less than 1 inch long; few black stains and rounded concretions; neutral; clear smooth boundary.

Cr—57 inches; light olive brown (2.5Y 5/4), silty shale.

The depth to weathered shale bedrock ranges from 40 to more than 60 inches. The mollic epipedon is 10 to 24 inches thick. Reaction ranges from strongly acid to neutral throughout the profile.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 (3 to 5 dry), and chroma of 1 to 3. It is typically silt loam, but the range includes clay loam and silty clay loam.

The Bt horizon has hue of 10YR to 5YR, value of 3 to 5 (4 to 6 dry), and chroma of 2 to 4. In many pedons mottles with higher chroma, redder hue, or both are below the mollic epipedon. The Bt horizon is silty clay loam or clay loam.

Some pedons have a C horizon. This horizon has hue of 5YR to 2.5Y, value of 4 to 6 (5 to 7 dry), and chroma of 2 to 6. It is distinctly mottled or variegated with colors within this range. In many pedons it has few or common fragments of soft shale and fine grained sandstone. It is silty clay loam, clay loam, or silty clay.

Eudora Series

The Eudora series consists of deep, well drained, moderately permeable soils on stream terraces along the Kansas River. These soils formed in silty alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Eudora silt loam, 1,450 feet east and 150 feet north of the southwest corner of sec. 15, T. 10 S., R. 10 E.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable, slightly hard; many fine and medium roots; mildly alkaline; clear smooth boundary.

A—10 to 15 inches; very dark brown (10YR 2/2) silt loam, very dark grayish brown (10YR 3/2) dry; moderate fine granular structure; friable, slightly hard; many fine and medium roots; mildly alkaline; clear smooth boundary.

AC—15 to 18 inches; dark grayish brown (10YR 4/2) and brown (10YR 5/3) silt loam, grayish brown (10YR 5/2) and pale brown (10YR 6/3) dry; weak fine granular structure; friable, slightly hard; common fine roots; mildly alkaline; clear smooth boundary.

C1—18 to 35 inches; brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; massive; very friable, slightly hard; few fine roots; few grayish brown patches; mildly alkaline; abrupt smooth boundary.

C2—35 to 60 inches; pale brown (10YR 6/3) silt loam, very pale brown (10YR 7/3) dry; a 3-inch layer of loamy fine sand in the lower part; common fine faint yellowish brown (10YR 5/4) mottles; massive; very friable, slightly hard; few fine roots; slight effervescence; moderately alkaline; abrupt smooth boundary.

The depth to free carbonates ranges from 20 to more than 60 inches. The thickness of the mollic epipedon ranges from 10 to 24 inches.

The A horizon has value of 2 or 3 (3 to 5 dry) and chroma of 1 or 2. It is typically silt loam, but the range includes loam and very fine sandy loam. This horizon ranges from slightly acid to mildly alkaline.

The C horizon has value of 4 to 6 (5 to 7 dry) and chroma of 1 to 3. It is silt loam or very fine sandy loam. In some pedons it has thin strata with colors of lower value and varying textures. This horizon ranges from neutral to moderately alkaline.

Florence Series

The Florence series consists of deep, well drained, moderately slowly permeable soils on uplands (fig. 14). These soils formed in material weathered from cherty limestone. Slopes range from 3 to 15 percent.

Typical pedon of Florence cherty silt loam, in an area of Florence-Labette complex, 3 to 15 percent slopes; 2,500 feet west and 400 feet south of the northeast corner of sec. 5, T. 14 S., R. 10 E.

Figure 14.—Profile of a Florence cherty silt loam. Depth is marked in feet.

A—0 to 14 inches; very dark grayish brown (10YR 3/2) cherty silt loam, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; friable, slightly hard; many fine and medium roots; about 15 percent chert fragments ¼ inch to 2 inches in diameter; neutral; clear smooth boundary.

BA—14 to 18 inches; dark grayish brown (10YR 4/2) cherty silty clay loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; firm, hard; common fine roots; about 25 percent chert fragments ¼ inch to 4 inches in diameter; neutral; clear smooth boundary.

Bt1—18 to 26 inches; dark brown (7.5YR 4/4) very cherty silty clay, brown (7.5YR 5/4) dry; few fine prominent yellowish red (5YR 4/6) mottles; weak medium subangular blocky structure; very firm, very hard; few fine roots; few faint clay films on faces of peds; about 55 percent chert fragments as much as 6 inches in diameter; neutral; clear smooth boundary.

Bt2—26 to 36 inches; dark reddish brown (2.5YR 3/4) very cherty clay, reddish brown (2.5YR 4/4) dry; common medium prominent yellowish red (5YR 4/6) mottles; moderate medium subangular blocky structure; extremely firm, extremely hard; few fine roots; common faint clay films on faces of peds; few fine rounded black concretions; about 50 percent chert fragments as much as 10 inches in diameter; neutral; gradual smooth boundary.

Bt3—36 to 42 inches; dark reddish brown (2.5YR 3/4) very cherty clay, reddish brown (2.5YR 4/4) dry; common medium prominent yellowish red (5YR 4/6) mottles; moderate medium subangular blocky structure; extremely firm, extremely hard; few fine roots; common faint clay films on faces of peds; few fine rounded black concretions; about 40 percent chert fragments as much as 3 inches in diameter; neutral; gradual smooth boundary.

BC—42 to 56 inches; reddish brown (5YR 4/3) and red (2.5YR 4/6) cherty clay, reddish brown (5YR 4/4) and dark reddish brown (2.5YR 3/4) dry; weak fine blocky structure; extremely firm, extremely hard; few fine roots; few fine rounded black concretions; about 15 percent chert fragments 1 to 3 inches in diameter; reddish yellow (5YR 6/6) and pink (5YR 8/4) weathered limestone fragments in the lower 3 inches; mildly alkaline; clear smooth boundary.

R—56 inches; cherty limestone.

The depth to bedrock ranges from 40 to 60 inches. The mollic epipedon ranges from 10 to 20 inches in thickness.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 (3 or 4 dry), and chroma of 1 or 2. It is silt loam, silty clay loam, or the cherty or very cherty analogs of those textures. It ranges from medium acid to neutral.

The Bt horizon has hue of 7.5YR to 2.5YR; value of 3 to 5, moist or dry; and chroma of 3 to 6. It is cherty clay, very cherty clay, cherty silty clay, or very cherty silty clay. It ranges from slightly acid to mildly alkaline. In some pedons a few carbonate concretions or seams of calcium carbonate are in the lower part of this horizon.

Gymer Series

The Gymer series consists of deep, well drained, moderately slowly permeable soils on the side slopes of valley walls along the major rivers. These soils formed in reddish brown loess. Slopes range from 3 to 8 percent.

Typical pedon of Gymer silty clay loam, 3 to 8 percent slopes, 2,500 feet west and 700 feet south of the northeast corner of sec. 29, T. 10 S., R. 10 E.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable, slightly hard; common fine and medium roots; medium acid; clear smooth boundary.

A—6 to 11 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; weak medium subangular blocky structure; friable, slightly hard; common fine and medium roots; medium acid; clear smooth boundary.

BA—11 to 16 inches; very dark grayish brown (10YR 3/2) and dark brown (7.5YR 4/4) silty clay loam, dark brown (7.5YR 4/2) dry; moderate fine subangular blocky structure; firm, hard; few fine roots; slightly acid; gradual smooth boundary.

Bt1—16 to 21 inches; dark brown (7.5YR 4/4 and 7.5YR 4/2) silty clay loam, brown (7.5YR 5/4) dry; moderate fine and medium subangular blocky structure; firm, hard; few fine roots; common faint clay films on faces of peds; slightly acid; clear smooth boundary.

Bt2—21 to 30 inches; reddish brown (5YR 4/4) silty clay loam, reddish brown (5YR 5/4) dry; common medium faint dark reddish brown (5YR 3/4) mottles; moderate fine subangular blocky structure; firm, hard; few fine roots; common faint clay films on faces of peds; slightly acid; clear smooth boundary.

BC—30 to 48 inches; yellowish red (5YR 4/6) and reddish brown (5YR 4/4) silty clay loam, yellowish red (5YR 5/6) and reddish brown (5YR 4/4) dry; weak fine subangular blocky structure; friable, hard; slightly acid; diffuse smooth boundary.

C—48 to 60 inches; yellowish red (5YR 4/6) silty clay loam, yellowish red (5YR 5/6) dry; massive; friable, hard; few fine roots; few fine black stains; slightly acid.

The mollic epipedon is 10 to 20 inches thick. The solum ranges from slightly acid to strongly acid in the upper part and is slightly acid or medium acid in the lower part.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3 (3 to 5 dry), and chroma of 2 or 3. It is typically silty clay loam, but in some pedons it is silt loam. The Bt horizon has hue of 5YR or 7.5YR, value of 3 to 5 (4 to 6 dry), and chroma of 2 to 6. It is silty clay loam or silty clay. The content of clay ranges from 35 to 42 percent in the upper 20 inches of this horizon. The C horizon has hue of 5YR or 7.5YR, value of 4 or 5 (4 to 6 dry), and chroma of 4 to 6.

Haynie Series

The Haynie series consists of deep, well drained, moderately permeable soils on flood plains. These soils formed in calcareous, silty alluvium. Slopes are 0 to 1 percent.

Typical pedon of Haynie very fine sandy loam, occasionally flooded, 2,200 feet east and 900 feet north of the southwest corner of sec. 9, T. 10 S., R. 10 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) very fine sandy loam, grayish brown (10YR 5/2) dry; weak medium granular structure; friable, slightly hard; few fine and medium roots; mildly alkaline; abrupt smooth boundary.

C1—9 to 14 inches; dark brown (10YR 4/3) silt loam, brown (10YR 5/3) dry; weak fine granular structure; friable, hard; few fine roots; slight effervescence; mildly alkaline; clear smooth boundary.

C2—14 to 27 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; massive; friable, slightly hard; few fine roots; few fine tubular pores, vertically oriented; few threads of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C3—27 to 60 inches; brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; massive; friable, slightly hard; few fine roots; few fine tubular pores, vertically oriented; common ¼-inch lenses of very fine sandy loam; few fine soft masses of lime; strong effervescence; moderately alkaline.

The depth to free carbonates ranges from 0 to 10 inches. The A horizon has hue of 2.5Y or 10YR, value of 3 (4 or 5 dry), and chroma of 2. It is typically very fine sandy loam, but the range includes silt loam or silty clay loam. It is neutral or mildly alkaline. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5 (5 to 7 dry), and chroma of 2 to 4. It is dominantly silt loam or very fine sandy loam, but some pedons contain strata of fine sandy loam and loamy fine sand.

Irwin Series

The Irwin series consists of deep, moderately well drained, very slowly permeable soils on uplands. These soils formed in clayey sediments. Slopes range from 1 to 7 percent.

Typical pedon of Irwin silty clay loam, 1 to 3 percent slopes, 2,400 feet west and 550 feet north of the southeast corner of sec. 9, T. 14 S., R. 9 E.

A—0 to 12 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine and medium granular structure; friable, slightly hard; many fine and medium roots; medium acid; abrupt smooth boundary.

Bt1—12 to 17 inches; very dark grayish brown (10YR 3/2) and very dark brown (10YR 2/2) silty clay, grayish brown (10YR 5/2) and dark grayish brown (10YR 4/2) dry; common fine distinct dark brown (7.5YR 4/4) mottles; moderate medium subangular blocky structure; very firm, very hard; many fine and medium roots; few faint clay films on faces of peds; slightly acid; clear smooth boundary.

Bt2—17 to 24 inches; very dark grayish brown (10YR 3/2) clay, grayish brown (10YR 5/2) dry; common fine distinct dark brown (7.5YR 4/4) mottles; moderate medium blocky structure; very firm, very hard; common fine roots; common faint clay films on faces of peds; few rounded black concretions; slightly acid; gradual smooth boundary.

Bt3—24 to 35 inches; dark grayish brown (10YR 4/2) clay, brown (10YR 5/3) dry; common medium distinct dark brown (7.5YR 4/4) mottles; moderate medium blocky structure; very firm, very hard; common fine roots; common faint clay films on faces of peds; few rounded black concretions; neutral; gradual smooth boundary.

BC—35 to 42 inches; dark brown (10YR 4/3) silty clay, brown (10YR 5/3) dry; common fine distinct brown (7.5YR 5/4) mottles; moderate medium subangular blocky structure; very firm, very hard; few fine roots; few rounded black concretions; few concretions of lime; mildly alkaline; clear smooth boundary.

C—42 to 60 inches; dark reddish brown (5YR 3/3) clay, reddish brown (5YR 4/3) dry; common medium distinct reddish brown (5YR 4/4) and dark brown (7.5YR 4/2) mottles; weak medium subangular blocky structure; very firm, very hard; few rounded black concretions; few chert fragments less than ½ inch in diameter; mildly alkaline.

The mollic epipedon is 20 to 40 inches thick. A subhorizon in which the content of clay is more than 40 percent is within a depth of 14 inches.

The A horizon has value of 2 or 3 (4 or 5 dry) and chroma of 1 to 3. It is typically silty clay loam, but the range includes silt loam or clay loam. This horizon ranges from medium acid to neutral.

The Bt horizon has hue of 10YR or 7.5YR, value of 3 or 4 (4 to 6 dry), and chroma of 2 or 3. It is silty clay or clay. It typically ranges from slightly acid to mildly alkaline, but it can range from medium acid to moderately alkaline. Mottles with chroma of 3 or more are typical.

The C horizon has hue of 2.5Y to 5YR, value of 3 to 5 (4 to 6 dry), and chroma of 2 to 5 and is typically mottled. It ranges from neutral to moderately alkaline. It is silty clay, clay, or silty clay loam.

Ivan Series

The Ivan series consists of deep, well drained, moderately permeable soils on flood plains. These soils formed in calcareous, silty alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Ivan silt loam, occasionally flooded, 200 feet east and 600 feet south of the northwest corner of sec. 28, T. 11 S., R. 12 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable, slightly hard; many fine and medium roots; strong effervescence; mildly alkaline; clear smooth boundary.

A—8 to 21 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable, slightly hard; few fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

AC—21 to 36 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable, slightly hard; few fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C—36 to 60 inches; dark grayish brown (10YR 4/2) silt loam, brown (10YR 5/3) dry; massive; friable, slightly hard; few fine roots; strong effervescence; moderately alkaline.

The mollic epipedon ranges from 24 to 50 inches. The depth to free carbonates ranges from 0 to 10 inches.

The A horizon has value of 2 or 3 (4 or 5 dry) and chroma of 1 or 2. It is typically silt loam, but in some pedons it is silty clay loam. It is mildly alkaline or moderately alkaline.

The C horizon has value of 3 to 5 (5 to 7 dry) and chroma of 2 or 3. It is silt loam, loam, or silty clay loam.

Kimo Series

The Kimo series consists of deep, somewhat poorly drained, slowly permeable over moderately permeable soils on the terraces of the major rivers. These soils formed in clayey alluvium over contrasting lighter colored silty and loamy alluvium. Slopes are 0 to 1 percent.

Typical pedon of Kimo silty clay loam, in an area of Eudora-Kimo complex; 1,350 feet west and 2,500 feet south of the northeast corner of sec. 16, T. 10 S., R. 12 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak fine granular structure; firm, hard; common fine roots; slightly acid; clear smooth boundary.

A1—9 to 19 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; firm, hard; common fine roots; neutral; clear smooth boundary.

A2—19 to 24 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure; firm, hard; few fine roots; neutral; clear smooth boundary.

AC—24 to 35 inches; dark grayish brown (10YR 4/2) and brown (10YR 5/3) silty clay loam, grayish brown (10YR 5/2) and pale brown (10YR 6/3) dry; moderate fine subangular blocky structure; friable, hard; few fine roots; few very dark brown (10YR 2/2), clayey accumulations ½ inch to 1 inch in size; neutral; abrupt smooth boundary.

2C1—35 to 45 inches; brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; massive; friable, slightly hard; few fine roots; mildly alkaline; clear smooth boundary.

2C2—45 to 60 inches; stratified brown (10YR 5/3) and pale brown (10YR 6/3) very fine sandy loam, light gray (10YR 7/2) and very pale brown (10YR 7/3) dry; massive; very friable, soft; few fine roots in the upper 10 inches; slight effervescence; moderately alkaline.

The mollic epipedon is 16 to 24 inches thick. The depth to free carbonates ranges from 20 to more than 60 inches. Reaction ranges from slightly acid to moderately alkaline.

The A horizon has value of 2 or 3 (4 or 5 dry) and chroma of 1 or 2. It is typically silty clay loam, but in some pedons it is silty clay. Coarser surface textures occur in some overwash areas.

The 2C horizon has value of 4 to 6 (5 to 7 dry) and chroma of 2 or 3. It is silt loam, very fine sandy loam, or loamy very fine sand. The 2C horizon contains less than 18 percent clay and less than 15 percent fine sand or coarser sand. Thin strata of fine and coarser textured material are in some pedons.

Labette Series

The Labette series consists of moderately deep, well drained, slowly permeable soils on uplands. These soils formed in material weathered from interbedded cherty limestone and clayey shale (fig. 15). Slopes range from 2 to 5 percent.

Typical pedon of Labette silty clay loam, 2 to 5 percent slopes, 150 feet west and 350 feet north of the southeast corner of sec. 15, T. 15 S., R. 10 E.

A—0 to 8 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; strong fine and medium granular structure; firm, hard; many fine and medium roots; slightly acid; clear smooth boundary.

BA—8 to 16 inches; very dark grayish brown (10YR 3/2) silty clay, dark grayish brown (10YR 4/2) dry; moderate fine blocky structure; very firm, very hard; many fine and medium roots; few faint clay films on faces of peds; neutral; clear smooth boundary.

Bt1—16 to 19 inches; dark brown (7.5YR 4/4) and brown (7.5YR 4/2) silty clay, brown (7.5YR 5/4 and 7.5YR 5/2) dry; common medium distinct strong brown (7.5YR 4/6) mottles; moderate fine subangular blocky structure; very firm, very hard; common fine roots; few fine chert fragments; common faint clay films on faces of peds; mildly alkaline; clear smooth boundary.

Bt2—19 to 29 inches; dark brown (7.5YR 3/4) and brown (7.5YR 4/4) silty clay, brown (7.5YR 5/4 and 7.5YR 4/4) dry; common medium prominent

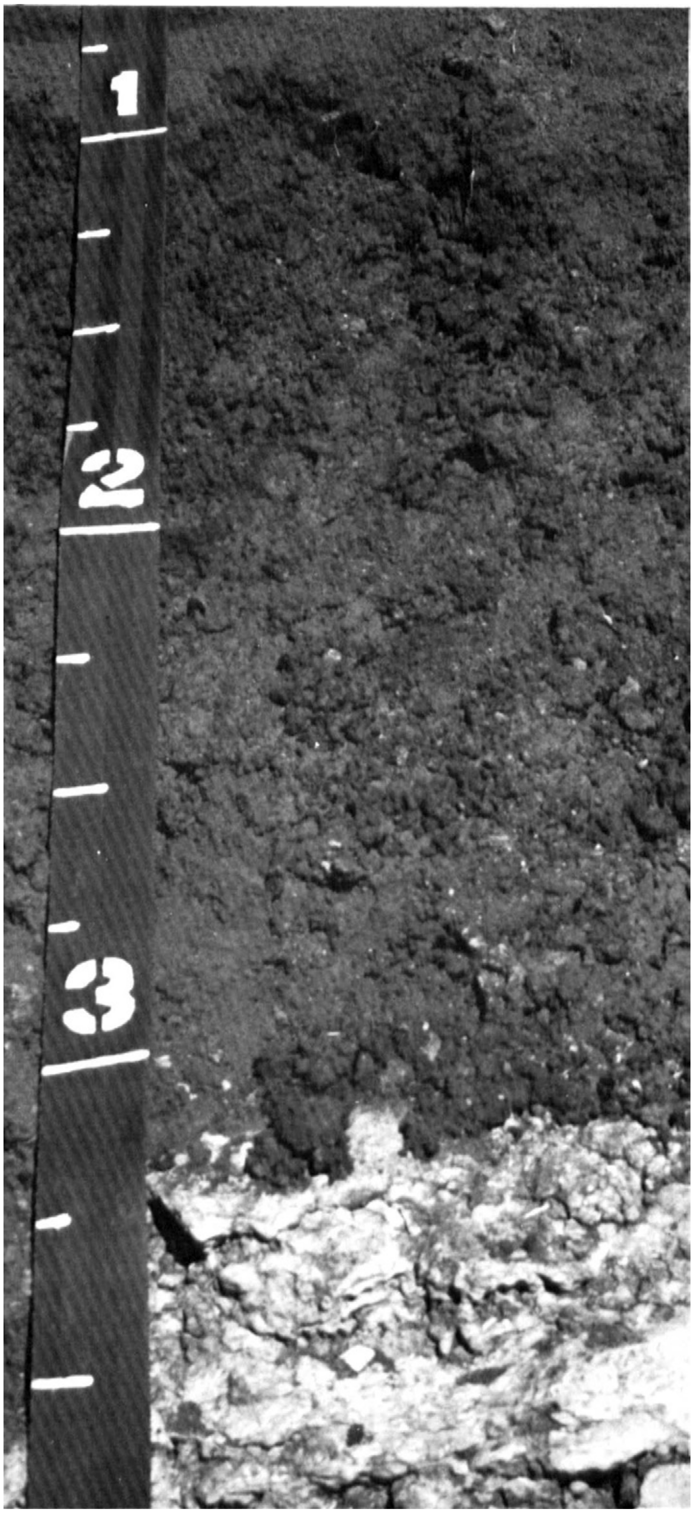

Figure 15.—Typical profile of a Labette silty clay loam. The depth to limestone is about 37 inches. Depth is marked in feet.

yellowish red (5YR 5/6) mottles; moderate fine subangular blocky structure; very firm, very hard; few fine roots; few faint clay films on faces of peds; few concretions of lime; few fine chert fragments; few black and brown stains; mildly alkaline; gradual smooth boundary.

Bt3—29 to 37 inches; dark reddish brown (5YR 3/4) silty clay, reddish brown (5YR 4/4) dry; common medium distinct yellowish red (5YR 5/6) mottles; moderate fine subangular blocky structure; very firm, very hard; few fine roots; few faint clay films on faces of peds; few fine chert fragments; few black concretions and stains; mildly alkaline; abrupt smooth boundary.

R—37 inches; cherty limestone.

The mollic epipedon ranges from 10 to 20 inches in thickness. The depth to bedrock ranges from 20 to 40 inches.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 (3 to 5 dry), and chroma of 1 or 2. It is typically silty clay loam, but in some pedons it is silt loam. It is medium acid or slightly acid.

The Bt horizon has hue of 7.5YR to 2.5YR, value of 3 to 5 (4 to 6 dry), and chroma of 2 to 6. It is silty clay, clay, or the cherty analogs of those textures. It ranges from medium acid to mildly alkaline.

Ladysmith Series

The Ladysmith series consists of deep, somewhat poorly drained, very slowly permeable soils on uplands. These soils formed in clayey sediments or old alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Ladysmith silty clay loam, 0 to 2 percent slopes, 300 feet east and 2,200 feet north of the southwest corner of sec. 5, T. 14 S., R. 9 E.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; firm, hard; common fine roots; medium acid; clear smooth boundary.

Bt1—8 to 13 inches; very dark brown (10YR 2/2) silty clay, dark grayish brown (10YR 4/2) dry; moderate fine blocky structure; very firm, very hard; common fine roots; few faint clay films on faces of peds; slightly acid; clear smooth boundary.

Bt2—13 to 25 inches; very dark grayish brown (10YR 3/2) clay, dark gray (10YR 4/1) dry; few fine distinct brown (10YR 5/3) mottles; moderate fine and medium blocky structure; very firm, very hard; few fine roots; common faint clay films on faces of peds; few black rounded concretions; neutral; clear smooth boundary.

Bt3—25 to 31 inches; dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) clay, grayish brown (10YR 5/2) dry; common fine distinct yellowish brown (10YR 5/4) mottles; few very dark gray (10YR 3/1) streaks; moderate fine and medium subangular blocky structure; very firm, very hard; few fine roots; few faint clay films on faces of peds; few black rounded concretions; mildly alkaline; clear smooth boundary.

BC—31 to 50 inches; grayish brown (10YR 5/2) silty clay, light brownish gray (10YR 6/2) dry; common fine distinct yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; very firm, very hard; few fine roots; few black rounded concretions and stains; few fine concretions of lime; moderately alkaline; clear smooth boundary.

C—50 to 60 inches; light brownish gray (10YR 6/2) silty clay, light gray (10YR 7/2) dry; common medium prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; very firm, very hard; few fine soft masses of lime; moderately alkaline.

The thickness of the mollic epipedon ranges from 20 to 40 inches. The depth to free carbonates ranges from 30 to 60 inches.

The A horizon has value of 2 or 3 (3 to 5 dry) and chroma of 1 or 2. It is typically silty clay loam, but in some pedons it is silt loam. It ranges from medium acid to neutral.

The Bt horizon has value of 2 or 3 (3 to 5 dry) and chroma of 1 or 2 in the upper part and hue of 10YR or 2.5Y, value of 3 or 4 (4 or 5 dry), and chroma of 1 or 2 in the lower part. It is silty clay or clay. It ranges from medium acid to mildly alkaline.

The C horizon has hue of 10YR or 2.5Y, value of 4 to 6 (5 to 7 dry), and chroma of 1 to 3. Most pedons have reddish or brownish mottles. It is silty clay, silty clay loam, or clay. It is mildly alkaline or moderately alkaline.

Martin Series

The Martin series consists of deep, moderately well drained, slowly permeable soils on uplands. These soils formed in material weathered from clayey shale. Slopes range from 3 to 7 percent.

Typical pedon of Martin silty clay loam, 3 to 7 percent slopes, 1,800 feet east and 450 feet south of the northwest corner of sec. 34, T. 10 S., R. 11 E.

A1—0 to 7 inches; black (10YR 2/1) silty clay loam, dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) dry; moderate fine and medium granular structure; friable, slightly hard; many fine and medium roots; slightly acid; abrupt smooth boundary.

A2—7 to 14 inches; black (10YR 2/1) silty clay loam, dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) dry; moderate fine subangular blocky structure; firm, hard; common fine roots; slightly acid; abrupt smooth boundary.

Bt1—14 to 34 inches; very dark grayish brown (10YR 3/2) silty clay, dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) dry; few fine faint dark grayish brown (10YR 4/2) and few fine prominent strong brown (7.5YR 5/6) mottles; moderate fine and medium subangular blocky structure; very firm, very hard; common fine roots; common faint clay films on faces of peds; few black rounded concretions; slightly acid; clear smooth boundary.

Bt2—34 to 49 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; few medium prominent yellowish brown (10YR 5/6) and common medium distinct grayish brown (10YR 5/2) mottles; weak fine subangular blocky structure; very firm, very hard; few fine roots; few faint clay films on faces of peds; few black stains; neutral; gradual smooth boundary.

BC—49 to 60 inches; dark grayish brown (10YR 4/2) silty clay, grayish brown (10YR 5/2) dry; common medium prominent strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; very firm, very hard; few fine roots; few black stains; neutral.

The mollic epipedon is 24 to 36 inches thick. The A horizon has value of 2 or 3 (3 or 4 dry) and chroma of 1 or 2. It is typically silty clay loam, but in some pedons it is silty clay. It is medium acid or slightly acid. The Bt horizon has hue of 10YR or 2.5Y, value of 2 to 4 (3 to 5 dry), and chroma of 1 or 2 in the upper part and 1 to 4 in the lower part. It is clay or silty clay. It ranges from medium acid to mildly alkaline.

Morrill Series

The Morrill series consists of deep, well drained, moderately slowly permeable soils on uplands. These soils formed in loamy glacial till. Slopes range from 4 to 12 percent.

Typical pedon of Morrill loam, 4 to 7 percent slopes, 2,200 feet east and 150 feet north of the southwest corner of sec. 8, T. 10 S., R. 11 E.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable, slightly hard; many fine roots; medium acid; clear smooth boundary.

BA—8 to 14 inches; dark brown (7.5YR 3/2) clay loam, dark brown (7.5YR 4/2) dry; moderate fine subangular blocky structure; friable, slightly hard; common fine and medium roots; medium acid; clear smooth boundary.

Bt1—14 to 26 inches; dark brown (7.5YR 4/4) and reddish brown (5YR 4/4) clay loam, brown (7.5YR 5/4) and strong brown (7.5YR 5/6) dry; moderate fine and medium subangular blocky structure; firm, hard; few fine roots; few faint clay films on faces of peds; slightly acid; clear smooth boundary.

Bt2—26 to 37 inches; reddish brown (5YR 4/4) clay loam, strong brown (7.5YR 5/6) dry; weak fine subangular blocky structure; firm, hard; few fine roots; few faint clay films on faces of peds; few black stains; slightly acid; clear smooth boundary.

C—37 to 60 inches; reddish brown (5YR 4/4) clay loam, yellowish red (5YR 5/6) dry; many medium and coarse prominent pale brown (10YR 6/3) mottles; massive; firm, hard; few black stains; slightly acid.

The mollic epipedon is 10 to 24 inches thick. Reaction ranges from neutral to strongly acid throughout the profile.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 (3 to 5 dry), and chroma of 1 to 3. It is typically loam, but the range includes clay loam, sandy loam, or gravelly sandy loam. The content of pebbles in this horizon ranges from 0 to 30 percent.

The Bt horizon has hue of 7.5YR or 5YR, value of 3 or 4 (4 or 5 dry), and chroma of 3 to 6. It is clay loam, sandy clay loam, gravelly clay loam, or gravelly sandy clay loam. The content of clay in this horizon ranges from 25 to 35 percent. The content of pebbles ranges from 0 to 20 percent.

The C horizon has hue of 10YR to 5YR, value of 4 or 5 (4 to 6 dry), and chroma of 3 to 6. It is clay loam, loam, sandy loam, sandy clay loam, gravelly clay loam, or gravelly sandy loam.

Pawnee Series

The Pawnee series consists of deep, moderately well drained, slowly permeable soils on uplands. These soils formed in glacial till. Slopes range from 1 to 7 percent.

Typical pedon of Pawnee clay loam, 3 to 7 percent slopes, 400 feet east and 500 feet north of the southwest corner of sec. 9, T. 11 S., R. 12 E.

A1—0 to 11 inches; very dark brown (10YR 2/2) clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable, slightly hard; many fine roots; medium acid; clear smooth boundary.

A2—11 to 17 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; common medium prominent brown (7.5YR 4/4) mottles; moderate medium granular structure; friable, hard; common fine roots; medium acid; clear smooth boundary.

Bt1—17 to 26 inches; dark grayish brown (10YR 4/2) clay, brown (10YR 5/3) dry; common medium prominent strong brown (7.5YR 4/6) mottles; moderate fine and medium subangular blocky structure; very firm, very hard; common fine roots; few faint clay films on faces of peds; neutral; clear smooth boundary.

Bt2—26 to 44 inches; dark brown (10YR 4/3) clay, brown (10YR 5/3) dry; common medium prominent strong brown (7.5YR 4/6) and distinct grayish brown (10YR 5/2) mottles; moderate fine subangular blocky structure; very firm, extremely hard; few fine roots; few faint clay films on faces of peds; few brown and black stains; moderately alkaline; clear smooth boundary.

Bt3—44 to 48 inches; brown (10YR 5/3) and pale brown (10YR 6/3) clay, pale brown (10YR 6/3) and very pale brown (10YR 7/3) dry; many medium prominent yellowish red (5YR 5/6) and reddish brown (5YR 5/4) mottles; weak fine subangular blocky structure; very firm, extremely hard; few faint clay films on faces of peds; few black rounded concretions; about 2 percent pebbles; few black stains; moderately alkaline; clear smooth boundary.

BC—48 to 60 inches; pale brown (10YR 6/3) and light gray (2.5Y 7/2) clay loam, very pale brown (10YR 7/3) and light gray (2.5Y 7/2) dry; common medium prominent strong brown (7.5YR 5/6) and reddish brown (5YR 4/4) mottles; weak fine blocky structure; very firm, very hard; about 5 percent pebbles; few concretions and masses of lime; mildly alkaline.

The mollic epipedon is 10 to 19 inches thick. The solum matrix is noncalcareous. The lower part of the Bt horizon, however, may contain a few carbonate concretions. The content of pebbles may be as much as 5 percent throughout the Bt and BC horizons. Reaction ranges from medium acid to neutral in the A horizon and the upper part of the Bt horizon and slightly acid to moderately alkaline in the lower part of the Bt horizon and in the BC horizon.

The A horizon has value of 2 or 3 (3 to 5 dry) and chroma of 1 or 2. It is typically clay loam, but the range includes loam and clay. The Bt horizon has hue of 10YR to 5Y, value of 3 to 5 (3 to 6 dry), and chroma of 2 to 4.

Paxico Series

The Paxico series consists of deep, somewhat poorly drained, moderately permeable soils on flood plains. These soils formed in alluvium. Slopes are 0 to 1 percent.

Typical pedon of Paxico silt loam, frequently flooded, 400 feet east and 1,200 feet north of the southwest corner of sec. 20, T. 10 S., R. 10 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable, slightly hard; common fine roots; few fine tubular pores; few black stains; strong effervescence; mildly alkaline; clear smooth boundary.

C1—8 to 15 inches; dark grayish brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable, slightly hard; few fine roots; few fine tubular pores; few fine strata of lighter and darker colored material; few black stains; strong effervescence; mildly alkaline; gradual smooth boundary.

C2—15 to 22 inches; dark grayish brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) dry; few fine distinct dark yellowish brown (10YR 4/6) mottles; massive; friable, slightly hard; few fine roots; common thin strata of lighter colored material; few black stains; strong effervescence; moderately alkaline; abrupt smooth boundary.

C3—22 to 28 inches; very dark grayish brown (10YR 3/2) and very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; common medium prominent strong brown (7.5YR 4/6) mottles; massive; firm, hard; few fine roots; few thin light colored silty strata; strong effervescence; moderately alkaline; abrupt smooth boundary.

C4—28 to 40 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; common medium distinct dark yellowish brown (10YR 4/6) mottles; massive; friable, slightly hard; few fine roots; many thin strata of lighter and darker colored material; strong effervescence; moderately alkaline; clear smooth boundary.

2C—40 to 60 inches; grayish brown (10YR 5/2) fine sandy loam, light gray (10YR 7/2) dry; common medium distinct dark yellowish brown (10YR 4/6) mottles; massive; friable, slightly hard; few fine roots; many thin strata; few strong brown stains around roots; strong effervescence; moderately alkaline.

The depth to carbonates ranges from 0 to 10 inches. Depth to the sandy underlying material ranges from 40 to more than 60 inches.

The A horizon has value of 2 to 4 (4 to 6 dry) and chroma of 1 or 2. It is typically silt loam, but in some pedons it is very fine sandy loam. It ranges from neutral to moderately alkaline.

The C horizon has value of 2 to 5 (4 to 7 dry) and chroma of 1 or 2. It is silt loam or very fine sandy loam. It is mildly alkaline or moderately alkaline.

The 2C horizon has value of 2 to 6 (4 to 7 dry) and chroma of 1 to 3. It is loamy fine sand, very fine sandy loam, or fine sand. Silty strata less than 6 inches thick are in some pedons.

Reading Series

The Reading series consists of deep, well drained and moderately well drained, moderately permeable and moderately slowly permeable soils on stream terraces. These soils formed in silty alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Reading silty clay loam, 1,300 feet west and 1,200 feet north of the southeast corner of sec. 32, T. 11 S., R. 11 E.

Ap—0 to 6 inches; very dark gray (10YR 3/1) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable, slightly hard; few fine roots; medium acid; clear smooth boundary.

AB—6 to 13 inches; very dark gray (10YR 3/1) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; firm, hard; few fine roots; few worm casts; medium acid; clear smooth boundary.

Bt1—13 to 26 inches; very dark grayish brown (10YR 3/2) silty clay loam, brown (10YR 4/3) and dark grayish brown (10YR 4/2) dry; strong very fine and fine blocky structure; firm, hard; few fine roots; few faint very dark brown (10YR 2/2) coatings on faces of peds; slightly acid; gradual smooth boundary.

Bt2—26 to 45 inches; dark brown (10YR 3/3) silty clay loam, grayish brown (10YR 5/2) dry; few fine distinct dark yellowish brown (10YR 4/6) mottles; moderate fine subangular blocky structure; firm, hard; few fine roots; few faint very dark grayish brown (10YR 3/2) coatings on faces of peds; slightly acid; gradual smooth boundary.

C—45 to 60 inches; dark brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; many fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; firm, hard; very few fine roots; few brown stains and brown threads; neutral.

The mollic epipedon is more than 24 inches thick. The A horizon has value of 2 or 3 (3 to 5 dry) and chroma of 1 to 3. It is typically silty clay loam, but in some pedons it is silt loam. It is typically medium acid or slightly acid but ranges from medium acid to neutral. The Bt horizon has hue of 10YR or 7.5YR, value of 2 to 4 (3 to 5 dry), and chroma of 2 to 4. It is typically medium acid or slightly acid but ranges from medium acid to neutral. The C horizon has hue of 10YR or 7.5YR, value of 4 or 5 (5 or 6 dry), and chroma of 2 to 4. It is typically silty clay loam, but the range includes silty clay and clay loam. This horizon ranges from slightly acid to moderately alkaline.

Sarpy Series

The Sarpy series consists of deep, excessively drained, rapidly permeable soils on flood plains. These soils formed in sandy alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Sarpy loamy sand, frequently flooded, 200 feet east and 900 feet north of the southwest corner of sec. 3, T. 10 S., R. 11 E.

Ap—0 to 5 inches; very dark grayish brown (10YR 3/2) loamy sand, grayish brown (10YR 5/2) dry; weak fine granular structure parting to single grained; friable, slightly hard; few fine and medium roots; slight effervescence; mildly alkaline; clear smooth boundary.

C1—5 to 13 inches; brown (10YR 5/3) sand, pale brown (10YR 6/3) dry; single grained; loose; few fine roots; slight effervescence; moderately alkaline; gradual smooth boundary.

C2—13 to 60 inches; pale brown (10YR 6/3) sand, very pale brown (10YR 7/3) dry; single grained; loose; slight effervescence; moderately alkaline.

Reaction ranges from neutral to moderately alkaline throughout the profile. Some pedons do not have free carbonates in the upper 40 inches.

The A horizon has value of 3 to 5 (4 to 6 dry) and chroma of 1 to 3. It is typically loamy sand, but the range includes sand and fine sandy loam.

The C horizon has hue of 10YR or 2.5Y, value of 4 to 6 (5 to 7 dry), and chroma of 2 to 4. It is loamy fine sand or sand.

Sogn Series

The Sogn series consists of shallow, somewhat excessively drained, moderately permeable soils on uplands. These soils formed in material weathered from limestone. Slopes range from 5 to 20 percent.

Typical pedon of Sogn silty clay loam, in an area of Clime-Sogn silty clay loams, 5 to 20 percent slopes; 900 feet west and 2,850 feet north of the southeast corner of sec. 35, T. 12 S., R. 9 E.

A1—0 to 6 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium granular structure; friable, slightly hard; many fine and medium roots; 5 to 10 percent limestone fragments less than ½ inch in diameter; neutral; clear smooth boundary.

A2—6 to 13 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; moderate medium subangular blocky structure; firm, hard; many fine and medium roots; about 10 percent limestone fragments less than ½ inch in diameter; mildly alkaline; clear smooth boundary.

AC—13 to 17 inches; very dark grayish brown (10YR 3/2) channery silty clay loam, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; firm, hard; common fine roots; about 35 percent shale and limestone fragments; mildly alkaline; abrupt wavy boundary.

R—17 inches; limestone bedrock.

The thickness of the mollic epipedon and the depth to limestone range from 4 to 20 inches. Reaction ranges from slightly acid to moderately alkaline throughout the profile.

The A horizon has value of 2 or 3 (3 to 5 dry) and chroma of 1 to 3. It is typically silty clay loam, but in some pedons it is silt loam. The content of coarse fragments ranges from 0 to 15 percent.

The AC horizon, if it occurs, has colors similar to those of the A horizon. It is channery silty clay loam or channery silt loam. The content of coarse fragments ranges from 15 to 35 percent.

Tuttle Series

The Tuttle series consists of deep, somewhat excessively drained, slowly permeable soils on uplands. These soils formed in colluvium deposited over material weathered from calcareous shale and limestone. Slopes range from 20 to 60 percent.

Typical pedon of Tuttle channery silty clay loam, 20 to 60 percent slopes, stony, 500 feet east and 600 feet north of the southwest corner of sec. 15, T. 12 S., R. 10 E.

A—0 to 10 inches; very dark gray (10YR 3/1) channery silty clay loam, very dark grayish brown (10YR 3/2) dry; moderate fine granular structure; friable, slightly hard; many fine and medium roots; about 15 percent limestone channers and flagstones ¼ inch to 14 inches long; strong effervescence; mildly alkaline; clear smooth boundary.

Bw1—10 to 22 inches; very dark gray (10YR 3/1) channery silty clay, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; firm, very hard; many fine and medium roots; about 20 percent limestone channers ¼ inch to 6 inches long; strong effervescence; moderately alkaline; clear smooth boundary.

2Bw2—22 to 45 inches; grayish brown (2.5Y 5/2) channery silty clay loam, light brownish gray (2.5Y 6/2) dry; weak fine subangular blocky structure; firm, hard; common fine and medium roots; about 15 percent limestone and shale fragments ¼ inch to 2 inches long; violent effervescence; moderately alkaline; abrupt smooth boundary.

2C—45 to 54 inches; olive (5Y 5/3) silty clay, light brownish gray (2.5Y 6/2) and light gray (5Y 7/2) dry; massive; very firm, very hard; few fine and medium roots; few shale fragments ¼ inch to 2 inches long; violent effervescence; moderately alkaline; gradual smooth boundary.

2Cr—54 inches; partially weathered, calcareous, olive shale.

The mollic epipedon ranges from 20 to 27 inches in thickness. Free carbonates generally are at the surface. The depth to shale bedrock ranges from 40 to 60 inches.

The A horizon has value of 2 or 3, moist or dry, and chroma of 1 to 3. It is typically channery silty clay loam, but the range includes silty clay loam, clay loam, or channery clay loam. This horizon ranges from neutral to moderately alkaline. The content of limestone fragments less than 3 inches in size ranges from 0 to 30 percent. The content of limestone fragments more than 3 inches in size ranges from 5 to 30 percent. The total content of coarse fragments is less than 35 percent.

The Bw horizon has hue of 10YR or 7.5YR, value of 3 to 5 (3 to 6 dry), and chroma of 1 to 3. It is silty clay loam, silty clay, clay loam, or the channery analogs of those textures. The content of limestone fragments less than 3 inches in size ranges from 0 to 30 percent. The content of limestone fragments more than 3 inches in size ranges from 0 to 30 percent. The total content of coarse fragments is less than 35 percent.

The 2Bw horizon has hue of 5YR to 2.5Y, value of 3 to 6 (4 to 7 dry), and chroma of 1 to 4. It is silty clay loam, silty clay, or the channery analogs of those textures. The content of shale and weathered limestone fragments ranges from 0 to 30 percent.

Wabash Series

The Wabash series consists of deep, very poorly drained, very slowly permeable soils on flood plains (fig. 16). These soils formed in clayey alluvium. Slopes are 0 to 1 percent.

Typical pedon of Wabash silty clay, occasionally flooded, 500 feet west and 2,600 feet north of the southeast corner of sec. 29, T. 10 S., R. 12 E.

Ap—0 to 6 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; weak fine granular structure; very firm, very hard; few fine roots; slightly acid; abrupt smooth boundary.

A1—6 to 13 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; few fine faint dark gray (10YR 4/1) mottles; weak fine subangular blocky structure; very firm, very hard; few fine roots; neutral; gradual smooth boundary.

A2—13 to 22 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; few fine faint dark gray (10YR 4/1) mottles; moderate medium subangular blocky structure; extremely firm, extremely hard; few fine roots; neutral; gradual smooth boundary.

Bg1—22 to 30 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak medium blocky structure; extremely firm, extremely hard; few fine roots; few slickensides; few cracks filled with black (10YR 2/1) soil material; neutral; gradual smooth boundary.

Bg2—30 to 60 inches; dark gray (10YR 4/1) clay, gray (10YR 5/1) dry; common medium distinct grayish

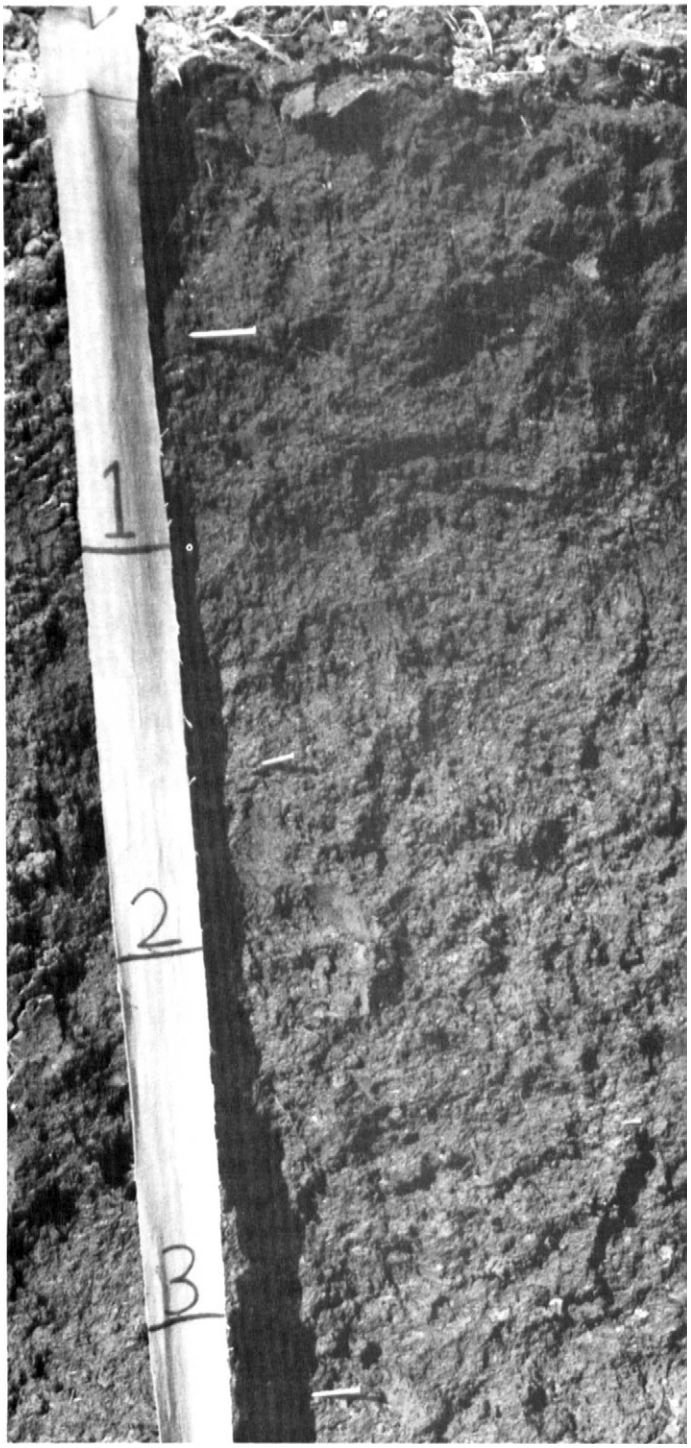

Figure 16.—Typical profile of a Wabash silty clay. Depth is marked in feet.

brown (10YR 5/2) and few fine distinct dark yellowish brown (10YR 4/4) mottles; moderate medium blocky structure; extremely firm, extremely hard; few slickensides; few cracks filled with black (10YR 2/1) soil material; mildly alkaline.

The solum typically ranges from medium acid to mildly alkaline. The depth to free carbonates is more than 40 inches.

The A horizon has hue of 10YR to 5Y, value of 2 or 3, moist or dry, and chroma of 2 or less. It is typically silty clay, but in some pedons it is silty clay loam.

The Bg horizon has hue of 10YR to 5Y, value of 2 to 5, moist or dry, and chroma of 2 or less. Mottles of higher chroma are commonly present in the darker upper part of the solum, and mottles of low chroma are mixed throughout the profile.

Wamego Series

The Wamego series consists of moderately deep, well drained, slowly permeable soils on uplands. These soils formed in material weathered from interbedded sandstone and silty shale. Slopes range from 3 to 15 percent.

Typical pedon of Wamego silty clay loam, 7 to 15 percent slopes, 2,500 feet west and 1,200 feet north of the southeast corner of sec. 17, T. 15 S., R. 13 E.

A—0 to 7 inches; very dark gray (10YR 3/1) silty clay loam, very dark grayish brown (10YR 3/2) dry; moderate fine granular structure; firm, slightly hard; many fine and medium roots; few sandstone fragments ½ inch to 6 inches long; slightly acid; gradual smooth boundary.

AB—7 to 11 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; firm, slightly hard; many fine and medium roots; few sandstone fragments ½ inch to 4 inches long; slightly acid; clear smooth boundary.

Bt1—11 to 17 inches; brown (10YR 4/3) and dark brown (10YR 3/3) silty clay loam, yellowish brown (10YR 5/4) and brown (10YR 5/3) dry; few fine prominent strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; firm, hard; some faces of peds are very dark grayish brown (10YR 3/2); few sandstone fragments ½ inch to 6 inches long; common fine and medium roots; few faint clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt2—17 to 25 inches; dark grayish brown (10YR 4/2) and brown (10YR 5/3) silty clay loam, brown (10YR 4/3) and pale brown (10YR 6/3) dry; common fine prominent strong brown (7.5YR 5/6) mottles;

moderate medium subangular blocky structure; firm, hard; few fine roots; few sandstone and shale fragments ½ inch to 6 inches long; few faint clay films on faces of peds; slightly acid; clear smooth boundary.

Cr—25 inches; grayish brown and light yellowish brown shale.

The depth to shale bedrock ranges from 20 to 40 inches. The thickness of the mollic epipedon is 7 to 18 inches. The content of shale and sandstone fragments ⅛ inch to 3 inches long ranges from 0 to 15 percent in any horizon. Fine mica flakes are common throughout many pedons.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3 (3 to 5 dry), and chroma of 1 or 2. It is typically silty clay loam, but the range includes silt loam and loam. It is medium acid or slightly acid.

The Bt horizon has hue of 5YR to 2.5Y, value of 3 to 5 (4 to 6 dry), and chroma of 2 to 4. It is silty clay loam, clay loam, or silty clay. This horizon ranges from medium acid to neutral.

Some pedons have a BC horizon. The content of shale and sandstone fragments in this horizon is as much as 35 percent.

Wymore Series

The Wymore series consists of deep, moderately well drained, slowly permeable soils on uplands. These soils formed in loess. Slopes range from 2 to 6 percent.

Typical pedon of Wymore silty clay loam, 2 to 6 percent slopes, 100 feet east and 1,000 feet north of the southwest corner of sec. 29, T. 10 S., R. 10 E.

Ap—0 to 8 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; firm, very hard; few fine roots; few medium and coarse sand grains; slightly acid; clear smooth boundary.

Bt1—8 to 14 inches; very dark grayish brown (10YR 3/2) silty clay, brown (10YR 4/3) dry; common fine faint brown (10YR 4/3) mottles; moderate medium subangular blocky structure; very firm, very hard; few fine roots; shiny coatings on faces of peds; neutral; clear smooth boundary.

Bt2—14 to 22 inches; dark brown (10YR 3/3) silty clay, brown (10YR 4/3 and 5/3) dry; common fine faint brown (10YR 4/3) mottles; moderate medium subangular blocky structure; very firm, very hard; few fine roots; common faint clay films on faces of peds; few very dark brown (10YR 2/2) krotovinas; neutral; clear smooth boundary.

Bt3—22 to 36 inches; brown (10YR 5/3) silty clay, pale brown (10YR 6/3) dry; common fine faint brown (10YR 5/3) mottles; moderate medium subangular blocky structure; very firm, very hard; few fine roots; common faint clay films on faces of peds; few black rounded concretions; few fine concretions of lime; neutral; abrupt smooth boundary.

BC—36 to 40 inches; grayish brown (2.5Y 5/2) silty clay, light brownish gray (2.5Y 6/2) dry; many medium prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very firm, very hard; few fine roots; few black stains; few fine and coarse concretions of lime; neutral; clear smooth boundary.

C1—40 to 52 inches; grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) silty clay loam, light brownish gray (2.5Y 6/2) dry; many medium prominent dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate fine subangular blocky; firm, hard; few fine roots; few black stains; few soft patches of lime; neutral; gradual smooth boundary.

C2—52 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam, light brownish gray (2.5Y 6/2) dry; many fine prominent strong brown (7.5YR 4/6) and many medium prominent yellowish brown (10YR 5/4) mottles; weak medium prismatic structure parting to moderate fine subangular blocky; firm, hard; few fine and medium sand grains; neutral.

The mollic epipedon ranges from 10 to 24 inches in thickness. Some pedons have buried horizons below the control section.

The A horizon has value of 2 or 3 (3 or 4 dry) and chroma of 1 or 2. It is typically silty clay loam, but in some pedons it is silty clay. It is medium acid or slightly acid. The Bt horizon has hue of 10YR or 2.5Y, value of 3 to 5 (4 to 6 dry), and chroma of 2 to 4. It is silty clay that ranges from 42 to 55 percent clay in the upper part and silty clay or silty clay loam in the lower part. This horizon ranges from medium acid to neutral. The C horizon has value of 5 or 6, moist or dry, and chroma of 1 or 2.

Formation of the Soils

Soil forms through processes that act on deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by the interaction of five factors of soil formation—the physical and mineralogical composition of the parent material, the climate under which the soil material accumulated and has existed since accumulation, the plant and animal life on and in the soil, the relief, and the length of time that the forces of soil formation have acted on the soil material. Each of these factors influences the formation of every soil, and each modifies the effects of the other four. The relative effects of the individual factors vary from place to place. The interactions among the factors are more complex for some soils than for others.

Parent Material

Parent material is the unconsolidated material in which soils form. It either is material weathered from rocks through freezing and thawing, abrasion, erosion, or chemical processes or is weathered material deposited by wind or water. The parent material affects texture, structure, color, natural fertility, and many other soil properties. Soils differ partly because of the various kinds of parent material. The texture of the parent material influences the rate of the downward movement of water and air and thus greatly affects soil formation. The composition of the parent material largely determines the mineralogical composition of the soil and, hence, its natural fertility.

The soils in Wabaunsee County formed in alluvium; glacial till and outwash; loess; shale, sandstone, and limestone residuum (fig. 17); and colluvium.

Pennsylvanian rocks are the oldest outcrops in the county. They occur as thin limestone beds alternating with thick shale beds and in places with sandstone beds. These rocks crop out along the west flank of the Nemaha range, a long, narrow anticline that cuts diagonally across the northwest corner of the county. They also crop out along the eastern border of the county. Elmont and Wamego soils formed in material weathered from these rocks.

Permian rocks crop out extensively east of the Nemaha range. They include cherty limestone, limestone, and shale. Florence soils formed in cherty limestone residuum, Sogn and Labette soils formed in limestone residuum, and Clime soils formed in shale residuum.

The northern fourth of the county is covered by glacial till. The till is an unsorted mixture of silt, sand, and clay having pebbles and a few stones or boulders that were transported and deposited by glacial ice. Pawnee soils formed in glacial till, and Morrill soils formed in glacial till or outwash.

Loess is wind-deposited material made up mainly of silt and clay particles. It is sometimes carried hundreds of miles from its source. Loess deposits of varying thickness cover the northern part of the county. Those on unstable landscapes generally have been removed by geologic erosion. Wymore soils formed in Peorian loess deposited during the Pleistocene. Gymer soils formed in loess deposits of undetermined age.

The colluvium in Wabaunsee County occurs as sediments that accumulated at the base of the steeper slopes as a result of gravity. Martin and Tuttle soils formed in silty and clayey colluvial material that generally weathered from shale.

Alluvium is material deposited by floodwater in stream and river valleys. It is a heterogeneous mixture of silt, clay, and sand washed from upland areas. Soils that formed in alluvium differ from one another, depending on the source of the material and the drainage characteristics. Chase, Eudora, Haynie, Ivan, Kimo, Paxico, Reading, Sarpy, and Wabash soils formed in alluvium.

Climate

Climate is an active factor of soil formation. It directly influences soil formation by weathering the parent material. It indirectly affects soil formation through its effect on plants and animals.

Figure 17.—An area of limestone. One of the kinds of parent material in Wabaunsee County is limestone residuum.

The climate of Wabaunsee County is typical continental. It is characterized by intermittent dry and moist periods, which can last for less than a year or for several years. The soil dries to varying depths during dry periods. It slowly regains moisture during wet periods and can become so saturated that excess moisture penetrates the substratum. Because of the wetting and drying, some of the basic nutrients, and even clay particles, have been leached from the upper horizons of some soils. Freezing and thawing cycles modify soil structure. In clayey soils they can result in soil aggregates, thus forming granular structure, which favors plant growth.

Plant and Animal Life

Plants and animals have important effects on soil formation. Plants generally influence the amount of nutrients and organic matter in the soil and the color of the surface layer. Ants, earthworms, cicadas, and other burrowing animals help to keep the soil open and porous. Bacteria and fungi help to decompose the plants, thus releasing plant nutrients.

Mid and tall grasses have had the greatest influence on soil formation in Wabaunsee County. As a result of the grasses, the upper part of a typical soil in the county is dark and is high in content of organic matter. The next part commonly is slightly finer textured and somewhat lighter colored than the layer above. The underlying parent material generally is light in color.

Relief

Relief, or the lay of the land, influences the formation of soils through its effect on drainage, runoff, plant cover, and soil temperature. Although climate and plants are the most active factors of soil formation, relief also is important, mainly because it significantly affects the movement of water on the surface and into the soil.

Runoff is more rapid on the steeper upland soils than on the less sloping soils. As a result, less water penetrates the surface and erosion is more extensive. Clime soils formed in old parent material, but relief has restricted their formation. Runoff is medium or rapid on these moderately sloping to steep soils, and much of the soil material is removed as soon as a soil forms.

Soils having well expressed horizons generally formed in the less sloping areas where runoff is slow, more water percolates through the profile, and erosion is less extensive. In areas where relief is gentle, the soils generally receive runoff from the higher areas.

Time

The length of time that the soil material has been subject to weathering and the soil-forming processes is commonly reflected in the degree of profile development. Soils that do not have well expressed horizons are in the earlier stages of development, whereas those that have well expressed horizons are in the later stages.

Profile development varies in the soils in Wabaunsee County. The soils on bottom land, such as Ivan soils, are subject to stream overflow. They receive new sediments with each period of flooding. They have a thick, dark surface layer but have weakly expressed lower horizons. As a result, they are considered to be in the early stages of development. In contrast, the more strongly developed Irwin, Ladysmith, Pawnee, and Wymore soils have well expressed horizons. Much of the clay in these soils has been translocated to the subsoil. Thousands of years were needed for the formation of these soils.

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Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

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.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

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—

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.

Bedding system. A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

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.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.

Chert. A compact siliceous rock of varying color composed of precipitated silica grains. Occurs in nodules or layers in limestone and shales.

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 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

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.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

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.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by 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). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 38 centimeters) long.

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.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

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 as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

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.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

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. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an 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) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying 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, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock 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.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

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 rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants 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 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 (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

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 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 in 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.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

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.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are—

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

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.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

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.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water concentration at saturation of all organic soil material.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. 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.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slick spot. 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 (7.6 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, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. 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.

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 soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

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.

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.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-76 at Eskridge, Kansas)

Month	Temperature					Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	In	In	In		In
January----	38.8	17.6	28.2	65	-10	0.89	0.24	1.73	2	5.1
February---	45.2	22.9	34.1	75	-4	1.08	.46	1.81	3	4.1
March------	54.1	29.8	42.0	84	3	2.15	.77	3.27	4	4.4
April------	67.7	42.6	55.2	88	22	3.57	2.41	4.66	6	1.2
May--------	76.7	52.9	64.8	93	33	4.37	2.96	6.03	7	.0
June-------	84.9	61.9	73.4	99	45	4.80	2.19	7.48	7	.0
July-------	90.6	66.2	78.4	105	51	4.46	2.04	6.38	6	.0
August-----	89.7	64.6	77.2	103	50	3.60	2.08	5.81	5	.0
September--	81.0	56.3	68.7	101	39	4.40	1.65	7.34	6	.0
October----	70.9	46.0	58.5	93	25	3.00	1.11	4.46	5	.0
November---	54.5	32.1	43.3	76	6	1.68	.20	2.69	3	1.6
December---	42.4	22.8	32.6	68	-6	1.39	.55	1.97	3	4.6
Year-----	66.4	43.0	54.7	105	-10	35.39	26.23	43.55	57	21.0

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1951-76 at Eskridge, Kansas)

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--	Apr. 8	Apr. 18	May 2
2 years in 10 later than--	Apr. 3	Apr. 13	Apr. 27
5 years in 10 later than--	Mar. 25	Apr. 3	Apr. 17
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 24	Oct. 17	Oct. 8
2 years in 10 earlier than--	Oct. 28	Oct. 22	Oct. 12
5 years in 10 earlier than--	Nov. 7	Oct. 31	Oct. 22

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-76 at Eskridge, Kansas)

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	207	190	163
8 years in 10	214	197	172
5 years in 10	227	211	188
2 years in 10	240	225	204
1 year in 10	247	232	212

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Ce	Chase silty clay loam	7,600	1.5
Cm	Clime silty clay loam, 3 to 7 percent slopes	3,200	0.6
Cr	Clime silty clay loam, 20 to 40 percent slopes, stony	9,450	1.8
Cs	Clime-Sogn silty clay loams, 5 to 20 percent slopes	140,200	27.6
Eo	Elmont silt loam, 3 to 7 percent slopes	7,100	1.4
Eu	Eudora silt loam	3,550	0.7
Ex	Eudora-Kimo complex	2,300	0.4
Fl	Florence-Labette complex, 3 to 15 percent slopes	59,850	11.7
Gy	Gymer silty clay loam, 3 to 8 percent slopes	1,500	0.3
He	Haynie very fine sandy loam, occasionally flooded	1,250	0.2
Ib	Irwin silty clay loam, 1 to 3 percent slopes	49,900	9.7
Id	Irwin silty clay loam, 3 to 7 percent slopes	16,337	3.2
Iv	Ivan silt loam, occasionally flooded	16,900	3.3
Ix	Ivan silty clay loam, channeled	13,150	2.6
La	Labette silty clay loam, 2 to 5 percent slopes	21,550	4.2
Lm	Ladysmith silty clay loam, 0 to 2 percent slopes	13,200	2.6
Mb	Martin silty clay loam, 3 to 7 percent slopes	74,650	14.6
Mc	Martin silty clay loam, 3 to 7 percent slopes, eroded	4,450	0.9
Mr	Morrill loam, 4 to 7 percent slopes	1,200	0.2
Ms	Morrill loam, 5 to 12 percent slopes, very stony	2,550	0.5
Pa	Pawnee clay loam, 1 to 3 percent slopes	3,400	0.7
Pn	Pawnee clay loam, 3 to 7 percent slopes	15,050	2.9
Po	Pawnee clay loam, 3 to 7 percent slopes, eroded	600	0.1
Px	Paxico silt loam, frequently flooded	1,250	0.2
Rb	Reading silt loam	850	0.2
Re	Reading silty clay loam	10,450	2.0
Sa	Sarpy loamy sand, frequently flooded	850	0.2
Sc	Sarpy-Haynie complex, occasionally flooded	1,100	0.2
Tz	Tuttle channery silty clay loam, 20 to 60 percent slopes, stony	3,450	0.7
Wb	Wabash silty clay, occasionally flooded	2,750	0.5
We	Wamego silty clay loam, 3 to 7 percent slopes	4,700	0.9
Wf	Wamego silty clay loam, 7 to 15 percent slopes	9,000	1.8
Wy	Wymore silty clay loam, 2 to 6 percent slopes	8,300	1.6
	Water	190	*
	Total	511,827	100.0

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
Ce	Chase silty clay loam
Eo	Elmont silt loam, 3 to 7 percent slopes
Eu	Eudora silt loam
Ex	Eudora-Kimo complex
Gy	Gymer silty clay loam, 3 to 8 percent slopes
He	Haynie very fine sandy loam, occasionally flooded
Ib	Irwin silty clay loam, 1 to 3 percent slopes
Id	Irwin silty clay loam, 3 to 7 percent slopes
Iv	Ivan silt loam, occasionally flooded
La	Labette silty clay loam, 2 to 5 percent slopes
Lm	Ladysmith silty clay loam, 0 to 2 percent slopes
Mb	Martin silty clay loam, 3 to 7 percent slopes
Mr	Morrill loam, 4 to 7 percent slopes
Pa	Pawnee clay loam, 1 to 3 percent slopes
Rb	Reading silt loam
Re	Reading silty clay loam
Wb	Wabash silty clay, occasionally flooded (where drained)
Wy	Wymore silty clay loam, 2 to 6 percent slopes

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE

(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)

Soil name and map symbol	Land capability	Winter wheat	Grain sorghum	Corn	Soybeans	Smooth bromegrass	Alfalfa hay
		Bu	Bu	Bu	Bu	AUM*	Tons
Ce-------------- Chase	IIw	39	69	82	36	8.0	4.5
Cm-------------- Clime	IVe	23	37	---	18	4.0	1.6
Cr-------------- Clime	VIIe	---	---	---	---	---	---
Cs-------------- Clime-Sogn	VIe	---	---	---	---	---	---
Eo-------------- Elmont	IIIe	37	64	80	32	6.5	3.6
Eu-------------- Eudora	I	44	76	125	45	7.5	5.0
Ex-------------- Eudora-Kimo	IIw	42	72	98	43	7.0	4.9
Fl-------------- Florence-Labette	VIe	---	---	---	---	---	---
Gy-------------- Gymer	IIIe	37	64	74	35	6.1	3.6
He-------------- Haynie	IIw	37	61	105	42	5.7	---
Ib-------------- Irwin	IIIe	36	61	42	24	5.0	3.0
Id-------------- Irwin	IVe	32	55	40	20	5.0	2.6
Iv-------------- Ivan	IIw	43	70	78	35	7.0	4.5
Ix-------------- Ivan	Vw	---	---	---	---	---	---
La-------------- Labette	IIIe	30	51	40	20	5.0	2.8
Lm-------------- Ladysmith	IIs	37	63	44	24	5.0	3.0
Mb-------------- Martin	IIIe	29	51	75	35	5.5	3.2
Mc-------------- Martin	IVe	26	45	65	27	4.5	2.6
Mr-------------- Morrill	IIIe	36	61	80	32	6.5	3.6

See footnote at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Winter wheat	Grain sorghum	Corn	Soybeans	Smooth bromegrass	Alfalfa hay
		Bu	Bu	Bu	Bu	AUM*	Tons
Ms-------------- Morrill	VIe	---	---	---	---	---	---
Pa-------------- Pawnee	IIe	33	55	67	28	5.5	3.7
Pn-------------- Pawnee	IIIe	29	49	64	26	5.0	3.5
Po-------------- Pawnee	IVe	21	41	58	25	4.5	3.0
Px-------------- Paxico	Vw	---	---	---	---	---	---
Rb-------------- Reading	I	47	80	92	44	6.5	5.0
Re-------------- Reading	I	47	80	74	35	6.5	4.5
Sa-------------- Sarpy	IVs	20	41	---	---	1.8	---
Sc-------------- Sarpy-Haynie	IIIw	29	48	---	---	3.4	---
Tz-------------- Tuttle	VIIe	---	---	---	---	---	---
Wb-------------- Wabash	IIIw	22	53	84	32	---	---
We-------------- Wamego	IVe	34	58	60	22	6.0	---
Wf-------------- Wamego	VIe	---	---	---	---	5.0	---
Wy-------------- Wymore	IIIe	32	53	70	30	---	3.3

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 7.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

(Only the soils that support rangeland vegetation suitable for grazing are listed)

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Ce: Chase	Loamy Lowland	Favorable	10,000	Big bluestem	40
		Normal	8,000	Indiangrass	15
		Unfavorable	6,000	Switchgrass	10
				Eastern gamagrass	10
				Prairie cordgrass	5
Cm, Cr: Clime	Limy Upland	Favorable	5,000	Little bluestem	30
		Normal	3,500	Big bluestem	20
		Unfavorable	2,500	Sideoats grama	10
				Indiangrass	10
				Switchgrass	5
				Jersey tea	5
				Leadplant	5
Cs*:					
Clime	Limy Upland	Favorable	5,000	Little bluestem	30
		Normal	3,500	Big bluestem	20
		Unfavorable	2,500	Sideoats grama	10
				Indiangrass	10
				Switchgrass	5
				Jersey tea	5
				Leadplant	5
Sogn	Shallow Limy	Favorable	3,500	Sideoats grama	25
		Normal	2,500	Big bluestem	25
		Unfavorable	1,500	Little bluestem	15
				Indiangrass	5
				Switchgrass	5
				Tall dropseed	5
Eo: Elmont	Loamy Upland	Favorable	5,500	Big bluestem	30
		Normal	4,500	Little bluestem	20
		Unfavorable	3,500	Indiangrass	15
				Switchgrass	10
				Eastern gamagrass	5
Eu: Eudora	Loamy Lowland	Favorable	9,000	Big bluestem	35
		Normal	7,000	Indiangrass	15
		Unfavorable	6,000	Eastern gamagrass	15
				Prairie cordgrass	10
				Switchgrass	5
Ex*:					
Eudora	Loamy Lowland	Favorable	9,000	Big bluestem	35
		Normal	7,000	Indiangrass	15
		Unfavorable	6,000	Eastern gamagrass	15
				Prairie cordgrass	10
				Switchgrass	5
Kimo	Clay Lowland	Favorable	9,000	Prairie cordgrass	40
		Normal	7,000	Big bluestem	15
		Unfavorable	5,000	Indiangrass	10
				Switchgrass	10
				Sedge	5
				Eastern gamagrass	5

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Fl*:					
Florence	Loamy Upland	Favorable	5,500	Big bluestem	35
		Normal	4,500	Little bluestem	20
		Unfavorable	3,500	Indiangrass	15
				Switchgrass	10
				Eastern gamagrass	5
Labette	Loamy Upland	Favorable	5,500	Big bluestem	30
		Normal	4,500	Little bluestem	20
		Unfavorable	3,500	Indiangrass	15
				Switchgrass	10
				Eastern gamagrass	5
Gy: Gymer	Loamy Upland	Favorable	6,000	Big bluestem	35
		Normal	5,000	Little bluestem	20
		Unfavorable	4,000	Indiangrass	15
				Switchgrass	5
				Eastern gamagrass	5
He: Haynie	Loamy Lowland	Favorable	8,500	Big bluestem	35
		Normal	6,500	Eastern gamagrass	15
		Unfavorable	5,000	Switchgrass	10
				Indiangrass	10
				Prairie cordgrass	10
Ib, Id: Irwin	Clay Upland	Favorable	5,000	Big bluestem	30
		Normal	3,500	Little bluestem	20
		Unfavorable	2,500	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5
Iv, Ix: Ivan	Loamy Lowland	Favorable	9,000	Big bluestem	40
		Normal	7,000	Indiangrass	20
		Unfavorable	6,000	Switchgrass	10
				Eastern gamagrass	10
				Prairie cordgrass	5
La: Labette	Loamy Upland	Favorable	5,500	Big bluestem	30
		Normal	4,500	Little bluestem	20
		Unfavorable	3,500	Indiangrass	15
				Switchgrass	10
				Eastern gamagrass	5
Lm: Ladysmith	Clay Upland	Favorable	5,000	Big bluestem	35
		Normal	3,500	Little bluestem	25
		Unfavorable	2,500	Switchgrass	10
				Indiangrass	10
				Tall dropseed	5
				Sideoats grama	5
Mb, Mc: Martin	Loamy Upland	Favorable	6,500	Big bluestem	40
		Normal	5,500	Little bluestem	15
		Unfavorable	4,000	Indiangrass	10
				Switchgrass	10
				Eastern gamagrass	10
Mr, Ms: Morrill	Loamy Upland	Favorable	6,000	Big bluestem	35
		Normal	5,000	Little bluestem	20
		Unfavorable	3,500	Indiangrass	10
				Switchgrass	5
				Eastern gamagrass	5

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
Pa, Pn, Po: Pawnee	Clay Upland	Favorable	6,000	Big bluestem	30
		Normal	4,000	Little bluestem	15
		Unfavorable	3,000	Switchgrass	10
				Tall dropseed	5
				Indiangrass	5
Rb, Re: Reading	Loamy Lowland	Favorable	9,000	Big bluestem	40
		Normal	7,000	Indiangrass	20
		Unfavorable	5,000	Switchgrass	10
				Eastern gamagrass	10
				Prairie cordgrass	5
Sa: Sarpy	Sandy Lowland	Favorable	7,000	Sand bluestem	30
		Normal	6,000	Switchgrass	15
		Unfavorable	4,500	Little bluestem	10
				Indiangrass	10
				Prairie sandreed	5
Sc*:					
Sarpy	Sandy Lowland	Favorable	7,000	Sand bluestem	30
		Normal	6,000	Switchgrass	15
		Unfavorable	4,500	Little bluestem	10
				Indiangrass	10
				Prairie sandreed	5
Haynie	Loamy Lowland	Favorable	8,500	Big bluestem	35
		Normal	6,500	Eastern gamagrass	15
		Unfavorable	5,000	Switchgrass	10
				Indiangrass	10
				Prairie cordgrass	10
Wb: Wabash	Clay Lowland	Favorable	9,000	Prairie cordgrass	40
		Normal	7,000	Switchgrass	15
		Unfavorable	6,000	Big bluestem	15
				Indiangrass	10
				Eastern gamagrass	5
We, Wf: Wamego	Loamy Upland	Favorable	6,000	Big bluestem	35
		Normal	4,500	Little bluestem	20
		Unfavorable	3,500	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5
				Eastern gamagrass	5
Wy: Wymore	Clay Upland	Favorable	5,000	Big bluestem	35
		Normal	3,600	Little bluestem	15
		Unfavorable	3,200	Switchgrass	10
				Indiangrass	5
				Sideoats grama	5
				Prairie dropseed	5
				Tall dropseed	5
				Sedge	5
				Kentucky bluegrass	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY

(Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available)

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Potential productivity: Common trees	Site index	Productivity class*	Trees to plant
Ce-------------- Chase	4C	Slight	Moderate	Moderate	Slight	Bur oak------------	62	---	Bur oak, green ash, eastern cottonwood, hackberry.
						Hackberry-----------	60	---	
						Green ash-----------	60	4	
						Eastern cottonwood--	66	---	
						Black walnut--------	55	---	
Eu-------------- Eudora	10A	Slight	Slight	Slight	Moderate	Eastern cottonwood--	105	10	Eastern cottonwood, green ash, black walnut.
						American sycamore---	---	---	
						Hackberry-----------	---	---	
						Black walnut--------	---	---	
						Green ash-----------	---	---	
Ex**:									
Eudora---------	10A	Slight	Slight	Slight	Moderate	Eastern cottonwood--	105	10	Eastern cottonwood, green ash, black walnut.
						American sycamore---	---	---	
						Hackberry-----------	---	---	
						Black walnut--------	---	---	
						Green ash-----------	---	---	
Kimo-----------	7A	Slight	Moderate	Moderate	Slight	White oak-----------	62	3	Eastern cottonwood, green ash, American sycamore, pecan.
						Eastern cottonwood--	90	7	
						Northern red oak----	---	---	
						Hackberry-----------	---	---	
						Green ash-----------	---	---	
He-------------- Haynie	11A	Slight	Slight	Slight	Moderate	Eastern cottonwood--	110	11	Black walnut, eastern cottonwood.
						American sycamore---	110	---	
						Black walnut--------	---	---	
						Green ash-----------	---	---	
Iv, Ix---------- Ivan	4A	Slight	Slight	Slight	Moderate	Bur oak------------	50	2	Black walnut, pecan, eastern cottonwood, green ash, hackberry, bur oak.
						Black walnut--------	73	4	
						Hackberry-----------	74	---	
						Green ash-----------	90	7	
						Silver maple--------	89	3	
Mb, Mc---------- Martin	3C	Slight	Moderate	Moderate	Moderate	White oak-----------	60	3	Black walnut, white oak, black oak, hackberry, green ash, shagbark hickory.
						Black walnut--------	68	---	
Mr-------------- Morrill	3A	Slight	Slight	Slight	Severe	White oak-----------	55	3	Black walnut, white oak, black oak, hackberry, green ash.
						Black walnut--------	---	---	
						Black oak-----------	55	3	

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Plant competition	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Productivity class*	Trees to plant
Ms-------------- Morrill	3X	Slight	Moderate	Slight	Severe	White oak-----------	55	3	Black walnut, white oak, black oak, hackberry, green ash.
						Black walnut--------	---	---	
						Black oak-----------	55	3	
Px-------------- Paxico	11W	Slight	Severe	Moderate	Moderate	Eastern cottonwood--	110	11	Black walnut, eastern cottonwood.
						Black walnut--------	73	---	
						Hackberry-----------	74	---	
						American sycamore---	110	---	
Rb, Re---------- Reading	4A	Slight	Slight	Slight	Moderate	Bur oak-------------	60	3	Black walnut, green ash, hackberry, bur oak, eastern cottonwood, northern red oak.
						Black walnut--------	73	4	
						Hackberry-----------	69	---	
						Shagbark hickory----	62	---	
						Northern red oak----	---	---	
Sa-------------- Sarpy	3S	Slight	Slight	Severe	Slight	Silver maple--------	90	3	Eastern cottonwood, American sycamore, black willow.
						Eastern cottonwood--	60	3	
Sc**:									
Sarpy----------	3S	Slight	Slight	Severe	Slight	Silver maple--------	90	3	Eastern cottonwood, American sycamore, silver maple.
						Eastern cottonwood--	60	3	
Haynie---------	11A	Slight	Slight	Slight	Moderate	Eastern cottonwood--	110	11	Black walnut, eastern cottonwood.
						American sycamore---	110	---	
						Black walnut--------	---	---	
						Green ash-----------	---	---	
Tz-------------- Tuttle	2R	Severe	Severe	Moderate	Moderate	Chinkapin oak-------	50	2	Bur oak, green ash, eastern cottonwood.
						Bitternut hickory---	---	---	
						Green ash-----------	20	2	
						Hackberry-----------	20	---	
						Eastern redbud------	---	---	
						Slippery elm--------	30	---	
Wb-------------- Wabash	4W	Slight	Severe	Severe	Severe	Pin oak-------------	75	4	Pin oak, pecan, eastern cottonwood.

* Productivity class is the yield in cubic meters per hectare per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--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)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ce----------------- Chase	---	American plum, Amur honeysuckle, Peking cotoneaster, lilac.	Eastern redcedar	Austrian pine, eastern white pine, bur oak, green ash, hackberry, honeylocust.	Eastern cottonwood.
Cm, Cr------------ Clime	Fragrant sumac----	Siberian peashrub	Eastern redcedar, green ash, Osageorange, Russian olive, black locust, honeylocust, northern catalpa, bur oak.	Siberian elm------	---
Cs*:					
Clime------------	Fragrant sumac----	Siberian peashrub	Eastern redcedar, green ash, Osageorange, Russian olive, black locust, honeylocust, northern catalpa, bur oak.	Siberian elm------	---
Sogn.					
Eo----------------- Elmont	Peking cotoneaster	Lilac, fragrant sumac, Amur honeysuckle.	Eastern redcedar, Russian olive, hackberry, green ash, bur oak.	Austrian pine, Scotch pine, honeylocust.	---
Eu----------------- Eudora	---	Peking cotoneaster, Amur honeysuckle, lilac, American plum.	Eastern redcedar	Austrian pine, bur oak, eastern white pine, honeylocust, hackberry, green ash.	Eastern cottonwood.
Ex*:					
Eudora-----------	---	Peking cotoneaster, Amur honeysuckle, lilac, American plum.	Eastern redcedar	Austrian pine, bur oak, eastern white pine, honeylocust, hackberry, green ash.	Eastern cottonwood.
Kimo-------------	---	Autumn olive, Amur honeysuckle, lilac, Amur maple.	Eastern redcedar	Green ash, hackberry, Austrian pine, eastern white pine, honeylocust, pin oak.	Eastern cottonwood.

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Fl*:					
Florence	Lilac, Peking cotoneaster, Amur honeysuckle, fragrant sumac.	---	Eastern redcedar, hackberry, bur oak, Austrian pine, green ash, Russian olive.	Honeylocust, Siberian elm.	---
Labette	Peking cotoneaster, lilac.	Amur honeysuckle, Siberian peashrub, Manchurian crabapple.	Russian olive, eastern redcedar, green ash, Austrian pine, hackberry.	Siberian elm, honeylocust.	---
Gy: Gymer	Lilac, Peking cotoneaster.	Manchurian crabapple, Siberian peashrub, Amur honeysuckle.	Eastern redcedar, Austrian pine, Russian olive, hackberry, green ash.	Siberian elm, honeylocust.	---
He: Haynie	Blackhaw	Siberian peashrub, common chokecherry.	Russian olive, Osageorange, eastern redcedar, Washington hawthorn.	Green ash, hackberry, honeylocust, bur oak.	Eastern cottonwood.
Ib, Id: Irwin	Lilac, Peking cotoneaster.	Manchurian crabapple, Amur honeysuckle, Siberian peashrub.	Austrian pine, eastern redcedar, hackberry, green ash, Russian olive.	Siberian elm, honeylocust.	---
Iv, Ix: Ivan	Blackhaw	American plum, lilac, Peking cotoneaster, Amur honeysuckle.	Eastern redcedar, Russian olive, Osageorange.	Honeylocust, green ash, hackberry, bur oak.	Eastern cottonwood.
La: Labette	Peking cotoneaster, lilac.	Amur honeysuckle, Siberian peashrub, Manchurian crabapple.	Russian olive, eastern redcedar, green ash, Austrian pine, hackberry.	Siberian elm, honeylocust.	---
Lm: Ladysmith	Lilac, Peking cotoneaster.	Amur honeysuckle, Siberian peashrub, Manchurian crabapple.	Eastern redcedar, Austrian pine, Russian olive, hackberry, green ash.	Siberian elm, honeylocust.	---
Mb, Mc: Martin	Peking cotoneaster, lilac.	Amur honeysuckle, Siberian peashrub, Manchurian crabapple.	Green ash, hackberry, Austrian pine, eastern redcedar, Russian olive.	Honeylocust, Siberian elm.	---
Mr, Ms: Morrill	Peking cotoneaster	Amur honeysuckle, lilac, fragrant sumac.	Green ash, hackberry, Russian olive, eastern redcedar, bur oak.	Austrian pine, honeylocust, Scotch pine.	---

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Pa, Pn, Po: Pawnee	Amur honeysuckle, lilac, Siberian peashrub, Peking cotoneaster.	Eastern redcedar, Manchurian crabapple.	Austrian pine, Russian olive, green ash, hackberry, honeylocust.	Siberian elm	---
Px: Paxico	---	---	---	---	---
Rb: Reading	---	American plum, lilac, Peking cotoneaster, Amur honeysuckle.	Eastern redcedar	Austrian pine, green ash, bur oak, honeylocust, hackberry, eastern white pine.	Eastern cottonwood.
Re: Reading	---	Lilac, American plum, Peking cotoneaster, Amur honeysuckle.	Eastern redcedar	Austrian pine, bur oak, green ash, honeylocust, eastern white pine, hackberry.	Eastern cottonwood.
Sa: Sarpy	Blackhaw	Siberian peashrub, common chokecherry.	Eastern redcedar, Russian olive, Osageorange.	Bur oak, hackberry, green ash, honeylocust.	Eastern cottonwood.
Sc*:					
Sarpy	Blackhaw	Siberian peashrub	Washington hawthorn, Russian olive, eastern redcedar, Osageorange.	Bur oak, hackberry, green ash, honeylocust.	Eastern cottonwood.
Haynie	Blackhaw	Siberian peashrub, common chokecherry.	Russian olive, Osageorange, eastern redcedar, Washington hawthorn.	Green ash, hackberry, honeylocust, bur oak.	Eastern cottonwood.
Tz: Tuttle	Fragrant sumac, Siberian peashrub.	---	Eastern redcedar, Russian olive, Osageorange, northern catalpa, black locust, green ash, bur oak, honeylocust.	Siberian elm	---
Wb: Wabash	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Austrian pine, green ash, northern red oak, golden willow, honeylocust, silver maple.	Eastern cottonwood.
We, Wf: Wamego	Amur honeysuckle, lilac, Peking cotoneaster, fragrant sumac.	---	Eastern redcedar, Austrian pine, hackberry, green ash, bur oak, Russian olive.	Honeylocust, Siberian elm.	---

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Wy---------------- Wymore	Peking cotoneaster, skunkbush sumac, lilac.	Manchurian crabapple, Amur honeysuckle.	Eastern redcedar, Austrian pine, Russian olive, hackberry, green ash.	Honeylocust, Siberian elm.	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Ce: Chase	Severe: flooding.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Slight.
Cm: Clime	Slight	Slight	Moderate: slope, thin layer.	Severe: erodes easily.
Cr: Clime	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Cs*:				
Clime	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
Sogn	Severe: thin layer, area reclaim.	Severe: thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Slight.
Eo: Elmont	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight.
Eu: Eudora	Severe: flooding.	Slight	Slight	Slight.
Ex*:				
Eudora	Severe: flooding.	Slight	Slight	Slight.
Kimo	Severe: flooding.	Moderate: wetness, percs slowly.	Moderate: wetness.	Slight.
Fl*:				
Florence	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Severe: small stones.
Labette	Slight	Slight	Moderate: slope, small stones, thin layer.	Slight.
Gy: Gymer	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight.
He: Haynie	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Ib, Id: Irwin	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Iv: Ivan	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Ix: Ivan	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
La: Labette	Slight	Slight	Moderate: slope, small stones, thin layer.	Slight.
Lm: Ladysmith	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Slight.
Mb, Mc: Martin	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Severe: erodes easily.
Mr: Morrill	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones.	Slight.
Ms: Morrill	Moderate: slope, percs slowly.	Moderate: slope, large stones, percs slowly.	Severe: slope, large stones.	Slight.
Pa, Pn, Po: Pawnee	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
Px: Paxico	Severe: flooding.	Moderate: flooding, wetness.	Severe: flooding.	Moderate: wetness, flooding.
Rb, Re: Reading	Severe: flooding.	Moderate: percs slowly.	Moderate: percs slowly.	Slight.
Sa: Sarpy	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
Sc*:				
Sarpy	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Haynie	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Tz: Tuttle	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Wb: Wabash	Severe: flooding, wetness, percs slowly.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey, wetness.	Severe: wetness, too clayey.
We: Wamego	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, thin layer, area reclaim.	Slight.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Wf: Wamego	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight.
Wy: Wymore	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Ce----------------- Chase	Good	Good	Good	Good	Good	Good	Good	Fair	Good	Good	Fair	---
Cm----------------- Clime	Fair	Fair	Good	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Cr----------------- Clime	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Cs*:												
Clime--------------	Fair	Fair	Good	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Sogn---------------	Very poor.	Very poor.	Poor	---	---	Poor	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
Eo----------------- Elmont	Fair	Good	Good	Fair	Fair	Good	Poor	Very poor.	Good	Fair	Very poor.	Good.
Eu----------------- Eudora	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	---
Ex*:												
Eudora-------------	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	---
Kimo---------------	Good	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good	---
Fl*:												
Florence-----------	Poor	Good	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
Labette------------	Fair	Good	Fair	---	---	Fair	Poor	Poor	Fair	---	Poor	Fair.
Gy----------------- Gymer	Fair	Good	Fair	Good	Good	Good	Poor	Very poor.	Fair	---	Very poor.	Fair.
He----------------- Haynie	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
Ib----------------- Irwin	Good	Good	Good	---	---	Fair	Poor	Poor	Good	---	Poor	Fair.
Id----------------- Irwin	Fair	Good	Good	---	---	Fair	Poor	Poor	Fair	---	Poor	Fair.
Iv----------------- Ivan	Good	Good	Good	Good	Good	Good	Poor	Fair	Good	Good	Poor	Good.
Ix----------------- Ivan	Poor	Fair	Fair	Good	Good	Good	Poor	Fair	Fair	Good	Poor	Good.
La----------------- Labette	Fair	Good	Fair	---	---	Fair	Poor	Poor	Fair	---	Poor	Fair.
Lm----------------- Ladysmith	Fair	Good	Good	---	---	Good	Poor	Fair	Good	---	Poor	Good.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Mb, Mc-------------- Martin	Fair	Good	Good	Fair	Fair	Good	Poor	Very poor.	Good	Fair	Very poor.	Good.
Mr------------------ Morrill	Fair	Good	Good	Fair	Fair	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
Ms------------------ Morrill	Very poor.	Poor	Good	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.	Good.
Pa, Pn, Po---------- Pawnee	Fair	Good	Good	---	Fair	Fair	Very poor.	Poor	Good	---	Poor	Fair.
Px------------------ Paxico	Poor	Fair	Fair	Good	Good	---	Good	Good	Fair	Good	Fair	---
Rb, Re-------------- Reading	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	---
Sa------------------ Sarpy	Poor	Poor	Fair	Poor	Poor	---	Very poor.	Very poor.	Poor	Poor	Very poor.	---
Sc*:												
Sarpy--------------	Poor	Poor	Fair	Poor	Poor	---	Very poor.	Very poor.	Poor	Poor	Very poor.	---
Haynie-------------	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
Tz------------------ Tuttle	Very poor.	Very poor.	Good	Fair	Fair	Good	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Good.
Wb------------------ Wabash	Poor	Poor	Poor	Poor	Poor	---	Poor	Good	Poor	Poor	Fair	---
We------------------ Wamego	Fair	Good	Fair	Fair	Fair	Good	Poor	Very poor.	Fair	Fair	Very poor.	Fair.
Wf------------------ Wamego	Poor	Fair	Fair	Fair	Fair	Good	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
Wy------------------ Wymore	Fair	Good	Fair	Good	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Ce----------------- Chase	Severe: wetness.	Severe: flooding, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, frost action.
Cm----------------- Clime	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Cr----------------- Clime	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
Cs*:					
Clime------------	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.
Sogn-------------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.
Eo----------------- Elmont	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.
Eu----------------- Eudora	Slight-----------	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: frost action.
Ex*:					
Eudora-----------	Slight-----------	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: frost action.
Kimo-------------	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: frost action.
Fl*:					
Florence---------	Moderate: depth to rock, too clayey, large stones.	Moderate: shrink-swell, slope, large stones.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Severe: low strength.
Labette----------	Severe: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Gy----------------- Gymer	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
He----------------- Haynie	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding, frost action.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Ib, Id------------ Irwin	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Iv, Ix------------ Ivan	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.
La---------------- Labette	Severe: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Lm---------------- Ladysmith	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Mb, Mc------------ Martin	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.
Mr---------------- Morrill	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.
Ms---------------- Morrill	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, low strength, slope.
Pa, Pn, Po-------- Pawnee	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: low strength, frost action, shrink-swell.
Px---------------- Paxico	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding, frost action.
Rb---------------- Reading	Moderate: too clayey, wetness.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, frost action.
Re---------------- Reading	Moderate: too clayey.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, frost action.
Sa---------------- Sarpy	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Sc*:					
Sarpy------------	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Haynie-----------	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding, frost action.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Tz---------------- Tuttle	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
Wb---------------- Wabash	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.
We---------------- Wamego	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Wf---------------- Wamego	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.
Wy---------------- Wymore	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ce: Chase	Severe: wetness, percs slowly.	Slight	Severe: too clayey.	Moderate: flooding, wetness.	Poor: too clayey, hard to pack.
Cm: Clime	Severe: thin layer, seepage, percs slowly.	Severe: seepage.	Severe: seepage, too clayey.	Moderate: seepage.	Poor: area reclaim, too clayey, hard to pack.
Cr: Clime	Severe: thin layer, seepage, percs slowly.	Severe: seepage, slope.	Severe: seepage, slope, too clayey.	Severe: slope.	Poor: area reclaim, too clayey, hard to pack.
Cs*:					
Clime	Severe: thin layer, seepage, percs slowly.	Severe: seepage, slope.	Severe: seepage, too clayey.	Moderate: seepage, slope.	Poor: area reclaim, too clayey, hard to pack.
Sogn	Severe: thin layer, seepage.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage.	Severe: seepage.	Poor: area reclaim, thin layer.
Eo: Elmont	Severe: percs slowly.	Moderate: seepage, slope.	Severe: seepage, too clayey.	Slight	Poor: too clayey.
Eu: Eudora	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
Ex*:					
Eudora	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
Kimo	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
Fl*:					
Florence	Severe: percs slowly.	Severe: slope.	Severe: depth to rock, seepage, too clayey.	Moderate: slope.	Poor: too clayey, hard to pack, small stones.
Labette	Severe: thin layer, seepage, percs slowly.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage, too clayey.	Moderate: seepage.	Poor: area reclaim, too clayey, hard to pack.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Gy Gymer	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
He Haynie	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
Ib, Id Irwin	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
Iv, Ix Ivan	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
La Labette	Severe: thin layer, seepage, percs slowly.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage, too clayey.	Moderate: seepage.	Poor: area reclaim, too clayey, hard to pack.
Lm Ladysmith	Severe: wetness, percs slowly.	Slight	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
Mb, Mc Martin	Severe: wetness, percs slowly.	Moderate: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
Mr Morrill	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey, small stones.
Ms Morrill	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, small stones, slope.
Pa, Pn, Po Pawnee	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey, wetness.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Px Paxico	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Fair: wetness, thin layer.
Rb Reading	Severe: wetness, percs slowly.	Moderate: seepage, wetness.	Moderate: flooding, wetness, too clayey.	Moderate: flooding.	Fair: too clayey, thin layer.
Re Reading	Moderate: percs slowly.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey, thin layer.
Sa Sarpy	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, too sandy.	Severe: flooding, seepage.	Poor: seepage, too sandy.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Sc*:					
Sarpy	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, too sandy.	Severe: flooding, seepage.	Poor: seepage, too sandy.
Haynie	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
Tz Tuttle	Severe: percs slowly, slope.	Severe: slope.	Severe: seepage, slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
Wb Wabash	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
We Wamego	Severe: thin layer, seepage, percs slowly.	Severe: seepage.	Severe: seepage, too clayey.	Moderate: seepage.	Poor: area reclaim, too clayey.
Wf Wamego	Severe: thin layer, seepage, percs slowly.	Severe: seepage, slope.	Severe: seepage, too clayey.	Moderate: seepage, slope.	Poor: area reclaim, too clayey.
Wy Wymore	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness.	Severe: wetness.	Poor: hard to pack, wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ce: Chase	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Cm: Clime	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, too clayey.
Cr: Clime	Poor: area reclaim, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope, too clayey.
Cs*:				
Clime	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, too clayey.
Sogn	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, thin layer.
Eo: Elmont	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
Eu: Eudora	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Ex*:				
Eudora	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Kimo	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Fl*:				
Florence	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
Labette	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Gy: Gymer	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
He: Haynie	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ib, Id: Irwin	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Iv: Ivan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ix: Ivan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
La: Labette	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Lm: Ladysmith	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Mb, Mc: Martin	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Mr, Ms: Morrill	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, large stones.
Pa, Pn, Po: Pawnee	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Px: Paxico	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Rb: Reading	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Re: Reading	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Sa: Sarpy	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Sc*:				
Sarpy	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Haynie	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Tz: Tuttle	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones, area reclaim, slope.
Wb: Wabash	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, too clayey.
We, Wf: Wamego	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Wy: Wymore	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Ce: Chase	Slight	Severe: hard to pack.	Percs slowly, frost action.	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Erodes easily, percs slowly.
Cm: Clime	Moderate: seepage, slope.	Moderate: thin layer, hard to pack.	Deep to water	Slope, percs slowly, thin layer.	Area reclaim, erodes easily.	Erodes easily, area reclaim.
Cr: Clime	Severe: slope.	Moderate: thin layer, hard to pack.	Deep to water	Slope, percs slowly, thin layer.	Slope, area reclaim.	Slope, area reclaim.
Cs*:						
Clime	Severe: slope.	Moderate: thin layer, hard to pack.	Deep to water	Slope, percs slowly, thin layer.	Slope, area reclaim, erodes easily.	Slope, erodes easily, area reclaim.
Sogn	Severe: depth to rock, seepage, slope.	Severe: thin layer.	Deep to water	Slope, thin layer.	Slope, depth to rock, area reclaim.	Slope, depth to rock, area reclaim.
Eo: Elmont	Moderate: seepage, slope.	Moderate: thin layer.	Deep to water	Slope	Erodes easily	Erodes easily.
Eu: Eudora	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
Ex*:						
Eudora	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
Kimo	Moderate: seepage.	Severe: piping.	Percs slowly, frost action.	Wetness, percs slowly.	Erodes easily, wetness.	Erodes easily, percs slowly.
Fl*:						
Florence	Severe: slope.	Severe: hard to pack.	Deep to water	Slope, large stones, droughty.	Slope, large stones.	Large stones, slope, droughty.
Labette	Moderate: depth to rock, seepage, slope.	Severe: thin layer.	Deep to water	Slope, percs slowly, thin layer.	Depth to rock, area reclaim.	Erodes easily, depth to rock.
Gy: Gymer	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
He: Haynie	Moderate: seepage.	Severe: piping.	Deep to water	Soil blowing, erodes easily.	Erodes easily, soil blowing.	Erodes easily.
Ib: Irwin	Slight	Severe: hard to pack.	Deep to water	Percs slowly	Erodes easily, percs slowly.	Erodes easily, percs slowly.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Id----------------- Irwin	Moderate: slope.	Severe: hard to pack.	Deep to water	Slope, percs slowly.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Iv, Ix------------ Ivan	Moderate: seepage.	Moderate: piping.	Deep to water	Flooding--------	Favorable-------	Favorable.
La----------------- Labette	Moderate: depth to rock, seepage, slope.	Severe: thin layer.	Deep to water	Slope, percs slowly, thin layer.	Depth to rock, area reclaim.	Erodes easily, depth to rock.
Lm----------------- Ladysmith	Slight----------	Severe: hard to pack.	Percs slowly---	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Erodes easily, percs slowly.
Mb, Mc------------ Martin	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, frost action, slope.	Slope, wetness.	Erodes easily, wetness.	Erodes easily, percs slowly.
Mr----------------- Morrill	Moderate: seepage, slope.	Severe: thin layer.	Deep to water	Slope-----------	Favorable-------	Favorable.
Ms----------------- Morrill	Severe: slope.	Severe: thin layer.	Deep to water	Slope-----------	Slope-----------	Slope.
Pa----------------- Pawnee	Slight----------	Severe: hard to pack.	Percs slowly, frost action.	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily.
Pn, Po------------ Pawnee	Moderate: slope.	Severe: hard to pack.	Percs slowly, frost action, slope.	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily.
Px----------------- Paxico	Severe: seepage.	Severe: piping, wetness.	Flooding, frost action.	Wetness, erodes easily.	Erodes easily, wetness.	Erodes easily.
Rb, Re------------ Reading	Moderate: seepage.	Slight----------	Deep to water	Favorable-------	Erodes easily	Erodes easily.
Sa----------------- Sarpy	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake.	Too sandy, soil blowing.	Droughty.
Sc*:						
Sarpy------------	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake.	Too sandy, soil blowing.	Droughty.
Haynie-----------	Moderate: seepage.	Severe: piping.	Deep to water	Soil blowing, erodes easily.	Erodes easily, soil blowing.	Erodes easily.
Tz----------------- Tuttle	Severe: slope.	Moderate: thin layer, hard to pack, large stones.	Deep to water	Slope, large stones, percs slowly.	Slope, large stones, percs slowly.	Large stones, slope, percs slowly.
Wb----------------- Wabash	Slight----------	Severe: hard to pack, wetness.	Percs slowly, flooding.	Wetness, droughty, slow intake.	Wetness, percs slowly.	Wetness, droughty, percs slowly.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
We---------------- Wamego	Moderate: seepage, slope.	Severe: thin layer.	Deep to water	Slope, percs slowly, thin layer.	Area reclaim, erodes easily.	Erodes easily, area reclaim.
Wf---------------- Wamego	Severe: slope.	Severe: thin layer.	Deep to water	Slope, percs slowly, thin layer.	Slope, area reclaim, erodes easily.	Slope, erodes easily, area reclaim.
Wy---------------- Wymore	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Wetness, erodes easily.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	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	
Ce-----------------Chase	0-12	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-45	15-25
	12-56	Silty clay, silty clay loam, clay.	CH, CL	A-7, A-6	0	100	100	95-100	90-100	35-65	20-45
	56-60	Silty clay loam, silty clay.	CH, CL	A-7, A-6	0	100	100	95-100	90-100	35-60	20-40
Cm-----------------Clime	0-5	Silty clay loam	CL	A-6, A-7-6	0-5	90-100	90-100	85-100	80-95	40-50	20-25
	5-18	Silty clay, clay, silty clay loam.	CH, CL	A-7, A-6	0	95-100	95-100	95-100	85-95	45-65	20-40
	18-32	Silty clay, clay, silty clay loam.	CL, CH, SC	A-7	0	95-100	95-100	95-100	85-95	45-60	20-30
	32	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Cr-----------------Clime	0-9	Silty clay loam	CL, CH	A-7, A-6	.2-10	85-100	80-100	75-100	70-95	40-50	20-25
	9-27	Silty clay, clay, silty clay loam.	CH, CL	A-7, A-6	0	95-100	95-100	95-100	85-95	45-65	20-40
	27-33	Silty clay, clay	CL, CH	A-7	0	95-100	95-100	95-100	85-95	45-60	20-30
	33	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Cs*:											
Clime--------------	0-13	Silty clay loam	CL	A-6, A-7-6	0-5	90-100	90-100	85-100	80-95	40-50	20-25
	13-26	Silty clay, clay, silty clay loam.	CH, CL	A-7, A-6	0	95-100	95-100	95-100	85-95	45-65	20-40
	26-37	Silty clay, clay, silty clay loam.	CL, CH, SC	A-7	0	95-100	95-100	95-100	85-95	45-60	20-30
	37	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Sogn---------------	0-13	Silty clay loam	CL	A-6, A-7	0-10	90-100	85-100	80-100	70-95	36-43	15-20
	13-17	Channery silty clay loam.	CL, GC	A-6, A-7, A-4	0-15	60-95	50-85	45-85	36-80	28-43	10-20
	17	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Eo-----------------Elmont	0-19	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	75-100	25-40	6-15
	19-57	Silty clay loam, clay loam.	CL	A-6, A-7-6	0	100	100	95-100	85-100	35-45	15-25
	57	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Eu-----------------Eudora	0-15	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	95-100	60-100	20-35	2-11
	15-60	Silt loam, very fine sandy loam, loam.	ML, CL, CL-ML	A-4	0	100	100	95-100	80-100	<25	NP-10
Ex*:											
Eudora-------------	0-17	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	95-100	60-100	20-35	2-11
	17-60	Silt loam, very fine sandy loam, loam.	ML, CL, CL-ML	A-4	0	100	100	95-100	80-100	<25	NP-10

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Ex*:											
Kimo------------	0-19	Silty clay loam	CH, CL	A-7-6	0	100	100	95-100	90-100	45-65	20-40
	19-35	Silty clay loam, silty clay.	CH, CL	A-7-6	0	100	100	95-100	90-100	45-65	20-40
	35-60	Silt loam, very fine sandy loam, loamy very fine sand.	ML, CL-ML	A-4	0	100	100	95-100	50-100	<15	NP-4
Fl*:											
Florence--------	0-14	Cherty silt loam	GC, SC, CL	A-6, A-2-6	0-10	30-90	20-75	20-75	20-70	25-35	10-20
	14-18	Cherty silt loam, cherty silty clay loam, very cherty silty clay loam.	GC, SC, CL	A-6, A-2-6	5-20	30-75	15-70	15-70	15-65	25-35	10-20
	18-56	Very cherty silty clay, cherty clay, very cherty clay.	GC, SC, CH	A-2-7, A-7	10-40	30-90	20-80	20-75	15-70	50-75	30-45
	56	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Labette---------	0-7	Silt loam--------	CL, CL-ML	A-6, A-4	0	85-100	85-100	85-100	85-100	25-40	5-15
	7-35	Silty clay, silty clay loam, cherty silty clay.	CH, CL	A-7-6	0-20	75-100	70-100	65-100	60-100	40-60	20-35
	35	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Gy--------------- Gymer	0-11	Silty clay loam	CL	A-6	0	100	100	95-100	75-100	30-40	10-20
	11-30	Silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	95-100	85-100	35-55	15-30
	30-60	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-100	30-45	11-25
He--------------- Haynie	0-9	Very fine sandy loam.	CL-ML, ML	A-4	0	100	100	85-100	70-100	<25	NP-5
	9-60	Silt loam, very fine sandy loam.	CL-ML, CL	A-4, A-6	0	100	100	85-100	85-100	25-35	5-15
Ib, Id----------- Irwin	0-12	Silty clay loam	CL, ML	A-6, A-7-6	0	100	95-100	90-100	80-95	35-50	10-25
	12-42	Silty clay, clay	CH	A-7-6	0	100	95-100	95-100	85-95	50-70	25-45
	42-60	Silty clay, clay, silty clay loam.	CH, CL	A-7-6	0	100	100	95-100	80-95	40-65	20-45
Iv--------------- Ivan	0-36	Silt loam--------	CL	A-4, A-6	0	95-100	95-100	90-100	70-100	25-40	7-20
	36-60	Silt loam, silty clay loam, loam.	CL	A-4, A-6, A-7	0	95-100	95-100	90-100	65-100	25-45	7-25
Ix--------------- Ivan	0-40	Silty clay loam	CL	A-6, A-7	0	95-100	95-100	90-100	70-100	35-45	15-25
	40-60	Silt loam, silty clay loam, loam.	CL	A-4, A-6, A-7	0	95-100	95-100	90-100	65-100	25-45	7-25

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
La--------------- Labette	0-8	Silty clay loam	CL	A-6, A-7	0	85-100	85-100	85-100	85-100	30-50	10-25
	8-37	Silty clay, silty clay loam, cherty silty clay.	CH, CL	A-7-6	0-20	75-100	70-100	65-100	60-100	40-60	20-35
	37	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Lm--------------- Ladysmith	0-8	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-95	30-45	15-25
	8-31	Silty clay, clay	CH	A-7-6	0	100	100	95-100	85-95	50-70	30-50
	31-60	Silty clay, silty clay loam, clay.	CL, CH	A-7-6	0	100	100	95-100	85-95	40-65	25-45
Mb--------------- Martin	0-14	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	80-100	35-45	15-25
	14-60	Silty clay, clay	CH, CL	A-7	0	100	100	95-100	80-100	40-70	25-40
Mc--------------- Martin	0-6	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	80-100	35-45	15-25
	6-60	Silty clay, clay	CH, CL	A-7	0	100	100	95-100	80-100	40-70	25-40
Mr--------------- Morrill	0-8	Loam-------------	CL	A-4, A-6	0	95-100	75-100	65-100	50-80	25-40	7-20
	8-37	Clay loam, sandy clay loam, gravelly clay loam.	CL, SC	A-6, A-7-6	0	85-100	70-100	55-100	25-80	30-45	11-25
	37-60	Loam, clay loam, sandy clay loam.	CL, ML, SM, SC	A-4, A-6, A-2	0	90-100	70-100	45-100	20-80	20-35	2-15
Ms--------------- Morrill	0-15	Loam-------------	CL, SC	A-4, A-6	.2-10	80-100	75-100	65-95	50-80	30-35	10-15
	15-42	Clay loam, sandy clay loam, gravelly clay loam.	CL, SC	A-6, A-2, A-7-6	0	80-100	70-100	65-100	25-80	35-45	15-22
	42-60	Gravelly clay loam, gravelly sandy clay loam.	CL, SC	A-4, A-6, A-2	0	60-90	50-75	40-75	20-60	30-45	10-22
Pa, Pn----------- Pawnee	0-17	Clay loam--------	CL	A-6	0	95-100	95-100	85-100	70-90	30-40	10-20
	17-48	Clay-------------	CH	A-7	0	95-100	95-100	85-100	70-85	50-70	25-45
	48-60	Clay loam, sandy clay loam.	CL, CH	A-7, A-6	0	95-100	95-100	80-100	70-90	35-55	20-40
Po--------------- Pawnee	0-6	Clay loam--------	CL	A-6	0	95-100	95-100	85-100	70-90	30-40	10-20
	6-44	Clay-------------	CH	A-7	0	95-100	95-100	85-100	70-85	50-70	25-45
	44-60	Clay loam, sandy clay loam.	CL, CH	A-7, A-6	0	95-100	95-100	80-100	70-90	35-55	20-40
Px--------------- Paxico	0-8	Silt loam--------	ML, CL-ML, CL	A-4	0	100	100	85-100	75-90	15-30	NP-10
	8-40	Silt loam, very fine sandy loam.	ML, CL-ML, CL	A-4	0	100	100	85-100	80-90	15-30	NP-10
	40-60	Loamy fine sand, fine sandy loam, fine sand.	SM, SM-SC, ML, CL-ML	A-4, A-2	0	100	95-100	70-90	25-55	<25	NP-5
Rb--------------- Reading	0-15	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	85-100	25-40	5-20
	15-36	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	15-30
	36-60	Silty clay loam, clay loam, silty clay.	CL	A-6, A-7	0	100	100	95-100	80-100	35-50	15-30

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
Re-----------------Reading	0-13	Silty clay loam	CL	A-6	0	100	100	90-100	85-100	35-40	15-20
	13-45	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	15-30
	45-60	Silty clay loam, clay loam, silty clay.	CL	A-6, A-7	0	100	100	95-100	80-100	35-50	15-30
Sa-----------------Sarpy	0-5	Loamy sand-------	SM	A-2-4	0	100	100	60-80	15-35	---	NP
	5-60	Fine sand, loamy fine sand, sand.	SM, SP, SP-SM	A-2-4, A-3	0	100	100	60-80	2-35	---	NP
Sc*:											
Sarpy------------	0-6	Loamy sand-------	SM	A-2-4	0	100	100	60-80	15-35	---	NP
	6-60	Fine sand, loamy fine sand, sand.	SM, SP, SP-SM	A-2-4, A-3	0	100	100	60-80	2-35	---	NP
Haynie-----------	0-7	Fine sandy loam	CL-ML, ML	A-4	0	100	100	85-100	70-100	<25	NP-5
	7-60	Silt loam, very fine sandy loam.	CL-ML, CL	A-4, A-6	0	100	100	85-100	85-100	25-35	5-15
Tz-----------------Tuttle	0-10	Channery silty clay loam.	CL	A-6, A-7-6	5-35	85-100	80-100	80-100	75-95	35-50	15-25
	10-22	Channery silty clay loam, channery clay loam, channery silty clay.	CL	A-6, A-7-6	0-35	85-100	80-100	80-100	75-95	35-50	15-25
	22-54	Channery silty clay loam, silty clay loam, silty clay.	CL, CH	A-6, A-7-6	0-30	90-100	90-100	85-100	80-95	35-60	15-35
	54	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Wb-----------------Wabash	0-22	Silty clay-------	CH	A-7	0	100	100	100	95-100	50-75	30-50
	22-60	Silty clay, clay	CH	A-7	0	100	100	100	95-100	52-78	30-55
We, Wf------------Wamego	0-11	Silty clay loam	CL	A-6	0	100	100	90-100	60-95	30-40	10-20
	11-25	Silty clay loam, silty clay, clay loam.	CL	A-6, A-7-6	0	100	85-100	80-100	75-95	35-50	15-30
	25	Weathered bedrock	---	---	---	---	---	---	---	---	---
Wy-----------------Wymore	0-8	Silty clay loam	CL, CH, ML, MH	A-6, A-7	0	100	100	95-100	95-100	35-55	11-25
	8-40	Silty clay-------	CH	A-7	0	100	100	95-100	95-100	55-70	30-42
	40-60	Silty clay loam	CL, CH	A-6, A-7	0	100	100	95-100	85-100	35-55	20-35

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--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)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodi- bility group	Organic matter
									K	T		
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Ce---------------- Chase	0-12	27-35	1.30-1.45	0.2-0.6	0.21-0.23	5.6-7.3	<2	Moderate	0.37	5	7	2-4
	12-56	35-55	1.35-1.45	0.06-0.2	0.11-0.19	5.6-7.8	<2	High------	0.28			
	56-60	27-50	1.35-1.45	0.06-0.2	0.11-0.18	6.1-8.4	<2	High------	0.28			
Cm---------------- Clime	0-5	32-40	1.35-1.45	0.2-0.6	0.21-0.23	6.6-8.4	<2	Moderate	0.37	3	7	2-4
	5-18	35-60	1.35-1.50	0.06-0.2	0.12-0.18	7.4-8.4	<2	Moderate	0.28			
	18-32	35-50	1.40-1.50	0.06-0.2	0.10-0.14	7.4-8.4	<2	Moderate	0.28			
	32	---	---	---	---	---	---	----------	----			
Cr---------------- Clime	0-9	35-50	1.35-1.45	0.06-0.6	0.10-0.18	6.6-8.4	<2	Moderate	0.28	3	8	1-4
	9-27	35-60	1.35-1.50	0.06-0.2	0.12-0.18	7.4-8.4	<2	Moderate	0.28			
	27-33	35-50	1.40-1.50	0.06-0.2	0.10-0.14	7.4-8.4	<2	Moderate	0.28			
	33	---	---	---	---	---	---	----------	----			
Cs*:												
Clime-----------	0-13	32-40	1.35-1.45	0.2-0.6	0.21-0.23	6.6-8.4	<2	Moderate	0.37	3	7	2-4
	13-26	35-60	1.35-1.50	0.06-0.2	0.12-0.18	7.4-8.4	<2	Moderate	0.28			
	26-37	35-50	1.40-1.50	0.06-0.2	0.10-0.14	7.4-8.4	<2	Moderate	0.28			
	37	---	---	---	---	---	---	----------	----			
Sogn------------	0-13	27-35	1.15-1.20	0.6-2.0	0.19-0.24	6.1-8.4	<2	Moderate	0.32	1	4L	2-4
	13-17	18-35	1.15-1.20	0.6-2.0	0.18-0.23	6.1-8.4	<2	Moderate	0.32			
	17	---	---	---	---	---	---	----------	----			
Eo---------------- Elmont	0-19	15-27	1.30-1.40	0.6-2.0	0.22-0.24	5.1-7.3	<2	Low-------	0.32	5	6	2-4
	19-57	27-35	1.30-1.45	0.2-0.6	0.18-0.20	5.1-7.3	<2	Moderate	0.43			
	57	---	---	---	---	---	---	----------	----			
Eu---------------- Eudora	0-15	5-18	1.30-1.50	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low-------	0.32	5	6	1-4
	15-60	5-18	1.35-1.50	0.6-2.0	0.17-0.22	6.6-8.4	<2	Low-------	0.43			
Ex*:												
Eudora----------	0-17	5-18	1.30-1.50	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low-------	0.32	5	6	1-4
	17-60	5-18	1.35-1.50	0.6-2.0	0.17-0.22	6.6-8.4	<2	Low-------	0.43			
Kimo------------	0-19	35-40	1.20-1.30	0.06-0.2	0.13-0.22	6.1-8.4	<2	High------	0.37	5	7	2-4
	19-35	35-50	1.20-1.30	0.06-0.2	0.13-0.22	6.1-8.4	<2	High------	0.37			
	35-60	7-18	1.30-1.40	0.6-2.0	0.17-0.22	6.1-8.4	<2	Low-------	0.37			
Fl*:												
Florence--------	0-14	24-35	1.25-1.35	0.6-2.0	0.05-0.20	5.6-7.3	<2	Low-------	0.24	3	8	2-4
	14-18	24-35	1.35-1.45	0.6-2.0	0.03-0.20	5.6-7.3	<2	Low-------	0.24			
	18-56	50-80	1.35-1.55	0.2-0.6	0.03-0.12	6.1-7.8	<2	Moderate	0.24			
	56	---	---	---	---	---	---	----------	----			
Labette---------	0-7	18-27	1.30-1.40	0.6-2.0	0.22-0.24	5.6-6.5	<2	Low-------	0.37	3	7	2-4
	7-35	35-50	1.40-1.50	0.06-0.2	0.12-0.19	5.6-8.4	<2	High------	0.37			
	35	---	---	---	---	---	---	----------	----			
Gy---------------- Gymer	0-11	27-35	1.30-1.40	0.6-2.0	0.22-0.24	5.1-6.5	<2	Low-------	0.32	5	6	2-4
	11-30	35-42	1.40-1.50	0.2-0.6	0.12-0.20	5.6-6.5	<2	Moderate	0.43			
	30-60	27-35	1.30-1.40	0.6-2.0	0.18-0.20	5.6-6.5	<2	Moderate	0.43			
He---------------- Haynie	0-9	15-20	1.20-1.35	0.6-2.0	0.18-0.23	6.6-8.4	<2	Low-------	0.37	5	3	1-3
	9-60	15-18	1.20-1.35	0.6-2.0	0.18-0.23	7.4-8.4	<2	Low-------	0.37			

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Ib, Id----------- Irwin	0-12 12-42 42-60	28-35 40-55 35-55	1.35-1.45 1.40-1.50 1.40-1.50	0.2-0.6 <0.06 <0.2	0.18-0.23 0.10-0.15 0.09-0.15	5.6-7.3 5.6-8.4 6.6-8.4	<2 <2 <2	Moderate High------ High------	0.37 0.37 0.37	4	7	2-4
Iv--------------- Ivan	0-36 36-60	16-27 18-35	1.30-1.45 1.35-1.55	0.6-2.0 0.6-2.0	0.22-0.24 0.19-0.22	7.4-8.4 7.9-8.4	<2 <2	Low------- Moderate	0.32 0.32	5	4L	2-4
Ix--------------- Ivan	0-40 40-60	28-35 18-35	1.30-1.45 1.35-1.55	0.6-2.0 0.6-2.0	0.21-0.23 0.19-0.22	7.4-8.4 7.9-8.4	<2 <2	Moderate Moderate	0.32 0.32	5	4L	2-4
La--------------- Labette	0-8 8-37 37	28-35 35-50 ---	1.35-1.45 1.40-1.50 ---	0.2-0.6 0.06-0.2 ---	0.21-0.23 0.12-0.19 ---	5.6-6.5 5.6-8.4 ---	<2 <2 ---	Moderate High------ ----------	0.37 0.37 ----	3	7	2-4
Lm--------------- Ladysmith	0-8 8-31 31-60	28-35 40-60 35-55	1.35-1.45 1.35-1.50 1.40-1.60	0.2-0.6 <0.06 0.06-0.6	0.21-0.23 0.10-0.15 0.10-0.19	5.6-7.3 5.6-7.8 7.4-8.4	<2 <2 <2	Moderate High------ Moderate	0.37 0.37 0.37	4	7	2-4
Mb--------------- Martin	0-14 14-60	27-40 40-55	1.35-1.40 1.40-1.50	0.2-0.6 0.06-0.2	0.21-0.23 0.12-0.18	5.6-6.5 5.6-7.8	<2 <2	Moderate High------	0.37 0.37	4	7	2-4
Mc--------------- Martin	0-6 6-60	27-40 40-55	1.35-1.40 1.40-1.50	0.2-0.6 0.06-0.2	0.21-0.23 0.12-0.18	5.6-6.5 5.6-7.8	<2 <2	Moderate High------	0.37 0.37	4	7	1-3
Mr--------------- Morrill	0-8 8-37 37-60	15-29 25-35 10-29	1.30-1.40 1.35-1.45 1.40-1.55	0.6-2.0 0.2-0.6 0.6-2.0	0.14-0.21 0.15-0.19 0.15-0.18	5.1-7.3 5.1-7.3 5.1-7.3	<2 <2 <2	Low------- Moderate Low-------	0.28 0.28 0.37	5	6	1-4
Ms--------------- Morrill	0-15 15-42 42-60	18-27 27-35 18-35	1.30-1.40 1.35-1.45 1.40-1.55	0.6-2.0 0.2-0.6 0.6-2.0	0.18-0.22 0.15-0.19 0.10-0.13	5.1-7.3 5.1-7.3 5.1-7.3	<2 <2 <2	Low------- Moderate Low-------	0.20 0.32 0.24	5	8	1-4
Pa, Pn----------- Pawnee	0-17 17-48 48-60	30-38 40-50 25-35	1.40-1.50 1.50-1.70 1.40-1.50	0.2-0.6 0.06-0.2 0.06-0.2	0.17-0.19 0.09-0.11 0.14-0.16	5.6-7.3 6.1-8.4 7.4-8.4	<2 <2 <2	Moderate High------ High------	0.37 0.37 0.37	4	6	3-4
Po--------------- Pawnee	0-6 6-44 44-60	30-38 40-50 25-35	1.40-1.50 1.50-1.70 1.40-1.50	0.2-0.6 0.06-0.2 0.06-0.2	0.17-0.19 0.09-0.11 0.14-0.16	5.6-7.3 6.1-8.4 7.4-8.4	<2 <2 <2	Moderate High------ High------	0.37 0.37 0.37	4	6	2-3
Px--------------- Paxico	0-8 8-40 40-60	5-18 5-18 2-15	1.20-1.50 1.20-1.50 1.40-1.60	0.6-2.0 0.6-2.0 2.0-6.0	0.15-0.23 0.15-0.23 0.10-0.17	6.6-8.4 7.4-8.4 7.4-8.4	<2 <2 <2	Low------- Low------- Low-------	0.37 0.37 0.17	5	4L	1-3
Rb--------------- Reading	0-15 15-36 36-60	18-27 25-35 30-42	1.35-1.40 1.40-1.50 1.40-1.50	0.6-2.0 0.6-2.0 0.2-0.6	0.22-0.24 0.18-0.20 0.13-0.20	5.6-7.3 5.6-7.3 6.1-8.4	<2 <2 <2	Low------- Moderate Moderate	0.32 0.43 0.43	5	6	2-4
Re--------------- Reading	0-13 13-45 45-60	27-30 27-35 30-42	1.35-1.40 1.40-1.50 1.40-1.50	0.6-2.0 0.6-2.0 0.6-2.0	0.21-0.23 0.18-0.20 0.13-0.20	5.6-7.3 5.6-7.3 6.1-8.4	<2 <2 <2	Moderate Moderate Moderate	0.32 0.43 0.43	5	7	2-4
Sa--------------- Sarpy	0-5 5-60	2-5 2-5	1.20-1.50 1.20-1.50	6.0-20.0 6.0-20.0	0.05-0.09 0.05-0.09	6.6-8.4 7.4-8.4	<2 <2	Low------- Low-------	0.15 0.15	5	2	<1
Sc*:												
Sarpy-----------	0-6 6-60	2-5 2-5	1.20-1.50 1.20-1.50	6.0-20.0 6.0-20.0	0.05-0.09 0.05-0.09	6.6-8.4 6.6-8.4	<2 <2	Low------- Low-------	0.15 0.15	5	2	<1
Haynie----------	0-7 7-60	15-20 15-18	1.20-1.35 1.20-1.35	0.6-2.0 0.6-2.0	0.18-0.23 0.18-0.23	6.6-8.4 7.4-8.4	<2 <2	Low------- Low-------	0.37 0.37	5	3	1-3

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Tz----------------- Tuttle	0-10	32-40	1.35-1.45	0.2-0.6	0.10-0.18	6.6-8.4	<2	Moderate	0.20	4	8	1-4
	10-22	35-45	1.35-1.45	0.2-0.6	0.10-0.18	7.9-8.4	<2	Moderate	0.20			
	22-54	35-50	1.35-1.50	0.06-0.2	0.10-0.14	7.9-8.4	<2	Moderate	0.20			
	54	---	---	---	---	---	---	----------	----			
Wb----------------- Wabash	0-22	40-46	1.25-1.45	<0.06	0.12-0.14	5.6-7.3	<2	Very high	0.28	5	4	2-4
	22-60	40-60	1.20-1.45	<0.06	0.08-0.12	5.6-7.8	<2	Very high	0.28			
We, Wf------------ Wamego	0-11	27-32	1.30-1.50	0.6-2.0	0.21-0.24	5.6-6.5	<2	Low--------	0.32	4	7	2-4
	11-25	35-42	1.50-1.70	0.06-0.2	0.12-0.20	5.6-7.3	<2	Moderate	0.43			
	25	---	---	---	---	---	---	----------	----			
Wy----------------- Wymore	0-8	30-40	1.15-1.20	0.2-0.6	0.21-0.23	5.6-6.5	<2	Moderate	0.37	4	7	2-4
	8-40	42-55	1.10-1.20	0.06-0.2	0.11-0.14	5.6-7.3	<2	High-------	0.37			
	40-60	27-40	1.15-1.25	0.2-0.6	0.18-0.20	6.6-7.3	<2	High-------	0.37			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--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 less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Ce------------ Chase	C	Rare--------	---	---	2.0-4.0	Perched	Feb-May	>60	---	High-----	High-----	Low.
Cm, Cr---------- Clime	C	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	High-----	Low.
Cs*:												
Clime-----------	C	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	High-----	Low.
Sogn------------	D	None--------	---	---	>6.0	---	---	4-20	Hard	Moderate	Low------	Low.
Eo-------------- Elmont	B	None--------	---	---	>6.0	---	---	40-60	Soft	High-----	Moderate	Low.
Eu-------------- Eudora	B	Rare--------	---	---	>6.0	---	---	>60	---	High-----	Low------	Low.
Ex*:												
Eudora----------	B	Rare--------	---	---	>6.0	---	---	>60	---	High-----	Low------	Low.
Kimo------------	C	Rare--------	---	---	2.0-6.0	Apparent	Mar-Jun	>60	---	High-----	High-----	Low.
Fl*:												
Florence--------	C	None--------	---	---	>6.0	---	---	40-60	Hard	Moderate	Moderate	Low.
Labette---------	C	None--------	---	---	>6.0	---	---	20-40	Hard	Moderate	High-----	Low.
Gy-------------- Gymer	C	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
He-------------- Haynie	B	Occasional	Very brief	Feb-Nov	>6.0	---	---	>60	---	High-----	Low------	Low.
Ib, Id---------- Irwin	D	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
Iv-------------- Ivan	B	Occasional	Very brief	Dec-Jun	>6.0	---	---	>60	---	Moderate	Low------	Low.
Ix-------------- Ivan	B	Frequent----	Very brief	Dec-Jun	>6.0	---	---	>60	---	Moderate	Low------	Low.
La-------------- Labette	C	None--------	---	---	>6.0	---	---	20-40	Hard	Moderate	High-----	Low.

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Lm----------------- Ladysmith	D	None---------	---	---	2.0-3.0	Perched	Dec-Apr	>60	---	Moderate	High-----	Low.
Mb, Mc------------ Martin	C	None---------	---	---	2.0-3.0	Perched	Dec-Apr	>60	---	High-----	High-----	Low.
Mr, Ms------------ Morrill	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
Pa, Pn, Po-------- Pawnee	D	None---------	---	---	1.0-3.0	Perched	Dec-Apr	>60	---	High-----	High-----	Low.
Px---------------- Paxico	B	Frequent----	Brief to long.	Nov-Jun	1.5-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Low.
Rb---------------- Reading	B	Rare---------	---	---	3.5-6.0	Perched	Dec-Apr	>60	---	High-----	Moderate	Low.
Re---------------- Reading	B	Rare---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Low.
Sa---------------- Sarpy	A	Frequent----	Brief to long.	Nov-Jun	>6.0	---	---	>60	---	Low------	Low------	Low.
Sc*:												
Sarpy------------	A	Occasional	Brief to long.	Nov-Jun	>6.0	---	---	>60	---	Low------	Low------	Low.
Haynie-----------	B	Occasional	Very brief	Nov-Jun	>6.0	---	---	>60	---	High-----	Low------	Low.
Tz---------------- Tuttle	C	None---------	---	---	>6.0	---	---	40-60	Soft	Moderate	High-----	Low.
Wb---------------- Wabash	D	Occasional	Brief to long.	Nov-May	0-1.0	Apparent	Nov-May	>60	---	Moderate	High-----	Moderate.
We, Wf------------ Wamego	C	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate	Moderate.
Wy---------------- Wymore	D	None---------	---	---	1.0-3.0	Perched	Dec-Apr	>60	---	High-----	High-----	Moderate.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 19.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Chase	Fine, montmorillonitic, mesic Aquic Argiudolls
Clime	Fine, mixed, mesic Udorthentic Haplustolls
Elmont	Fine-silty, mixed, mesic Typic Argiudolls
Eudora	Coarse-silty, mixed, mesic Fluventic Hapludolls
Florence	Clayey-skeletal, montmorillonitic, mesic Udic Argiustolls
Gymer	Fine, montmorillonitic, mesic Typic Argiudolls
Haynie	Coarse-silty, mixed (calcareous), mesic Mollic Udifluvents
Irwin	Fine, mixed, mesic Pachic Argiustolls
Ivan	Fine-silty, mixed, mesic Cumulic Hapludolls
Kimo	Clayey over loamy, montmorillonitic, mesic Fluvaquentic Hapludolls
Labette	Fine, mixed, mesic Udic Argiustolls
Ladysmith	Fine, montmorillonitic, mesic Pachic Argiustolls
Martin	Fine, montmorillonitic, mesic Aquic Argiudolls
Morrill	Fine-loamy, mixed, mesic Typic Argiudolls
Pawnee	Fine, montmorillonitic, mesic Aquic Argiudolls
Paxico	Coarse-silty, mixed (calcareous), mesic Aeric Fluvaquents
Reading	Fine-silty, mixed, mesic Typic Argiudolls
Sarpy	Mixed, mesic Typic Udipsamments
Sogn	Loamy, mixed, mesic Lithic Haplustolls
Tuttle	Fine, mixed, mesic Pachic Haplustolls
Wabash	Fine, montmorillonitic, mesic Vertic Haplaquolls
Wamego	Fine, mixed, mesic Typic Argiudolls
Wymore	Fine, montmorillonitic, mesic Aquic Argiudolls

Interpretive Groups

INTERPRETIVE GROUPS

(Dashes indicate that the soil was not assigned to the interpretive group)

Map symbol	Map unit	Land capability*	Prime farmland*	Range site
Ce	Chase silty clay loam	IIw	Yes	Loamy Lowland.
Cm	Clime silty clay loam, 3 to 7 percent slopes	IVe	No	Limy Upland.
Cr	Clime silty clay loam, 20 to 40 percent slopes, stony	VIIe	No	Limy Upland.
Cs	Clime-Sogn silty clay loams, 5 to 20 percent slopes	VIe	No	
	Clime			Limy Upland.
	Sogn			Shallow Limy.
Eo	Elmont silt loam, 3 to 7 percent slopes	IIIe	Yes	Loamy Upland.
Eu	Eudora silt loam	I	Yes	Loamy Lowland.
Ex	Eudora-Kimo complex	IIw	Yes	
	Eudora			Loamy Lowland.
	Kimo			Clay Lowland.
Fl	Florence-Labette complex, 3 to 15 percent slopes	VIe	No	Loamy Upland.
Gy	Gymer silty clay loam, 3 to 8 percent slopes	IIIe	Yes	Loamy Upland.
He	Haynie very fine sandy loam, occasionally flooded	IIw	Yes	Loamy Lowland.
Ib	Irwin silty clay loam, 1 to 3 percent slopes	IIIe	Yes	Clay Upland.
Id	Irwin silty clay loam, 3 to 7 percent slopes	IVe	Yes	Clay Upland.
Iv	Ivan silt loam, occasionally flooded	IIw	Yes	Loamy Lowland.
Ix	Ivan silty clay loam, channeled	Vw	No	Loamy Lowland.
La	Labette silty clay loam, 2 to 5 percent slopes	IIIe	Yes	Loamy Upland.
Lm	Ladysmith silty clay loam, 0 to 2 percent slopes	IIs	Yes	Clay Upland.
Mb	Martin silty clay loam, 3 to 7 percent slopes	IIIe	Yes	Loamy Upland.
Mc	Martin silty clay loam, 3 to 7 percent slopes, eroded	IVe	No	Loamy Upland.
Mr	Morrill loam, 4 to 7 percent slopes	IIIe	Yes	Loamy Upland.
Ms	Morrill loam, 5 to 12 percent slopes, very stony	VIe	No	Loamy Upland.
Pa	Pawnee clay loam, 1 to 3 percent slopes	IIe	Yes	Clay Upland.
Pn	Pawnee clay loam, 3 to 7 percent slopes	IIIe	No	Clay Upland.
Po	Pawnee clay loam, 3 to 7 percent slopes, eroded	IVe	No	Clay Upland.
Px	Paxico silt loam, frequently flooded	Vw	No	---
Rb	Reading silt loam	I	Yes	Loamy Lowland.
Re	Reading silty clay loam	I	Yes	Loamy Lowland.
Sa	Sarpy loamy sand, frequently flooded	IVs	No	Sandy Lowland.
Sc	Sarpy-Haynie complex, occasionally flooded	IIIw	No	
	Sarpy			Sandy Lowland.
	Haynie			Loamy Lowland.
Tz	Tuttle channery silty clay loam, 20 to 60 percent slopes, stony	VIIe	No	---
Wb	Wabash silty clay, occasionally flooded	IIIw	Yes**	Clay Lowland.
We	Wamego silty clay loam, 3 to 7 percent slopes	IVe	No	Loamy Upland.
Wf	Wamego silty clay loam, 7 to 15 percent slopes	VIe	No	Loamy Upland.
Wy	Wymore silty clay loam, 2 to 6 percent slopes	IIIe	Yes	Clay Upland.

* A soil complex is treated as a single management unit in the land capability and prime farmland columns.
** Where drained.

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