United States
Department of
Agriculture

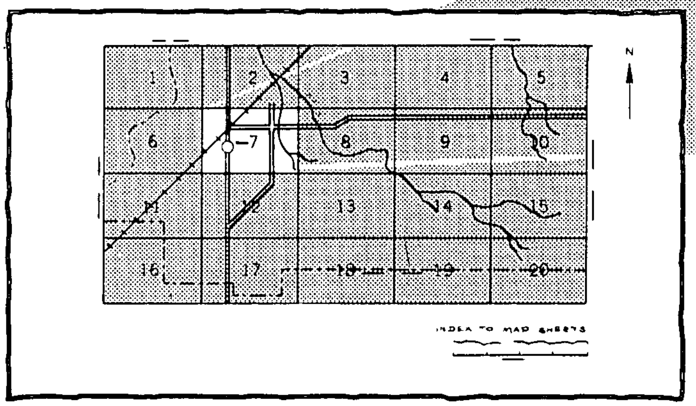
Soil
Conservation
Service

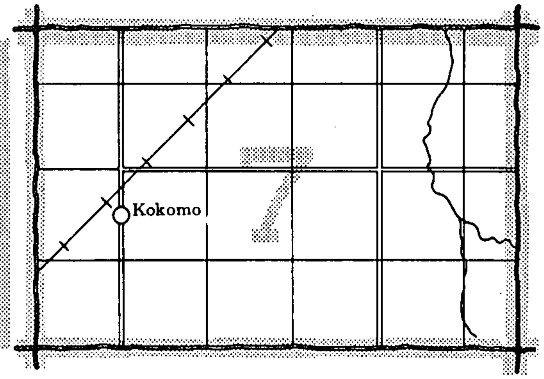
In cooperation with
Kansas Agricultural
Experiment Station

Soil Survey of Pottawatomie County, Kansas

HOW TO USE

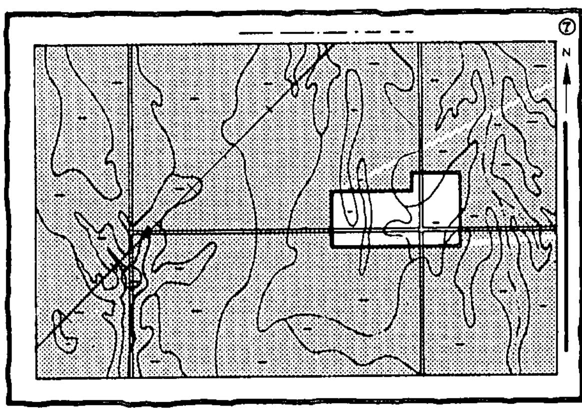
1. Locate your area of interest on the "Index to Map Sheets"

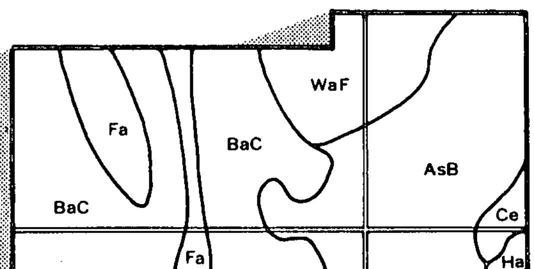




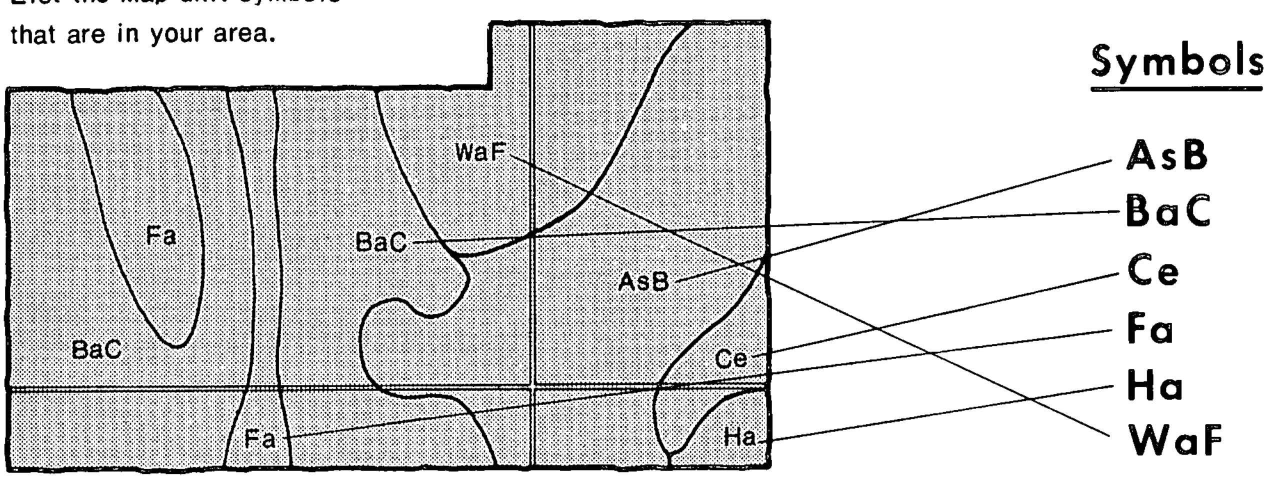
2. Note the number of the map sheet and turn to that sheet.

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



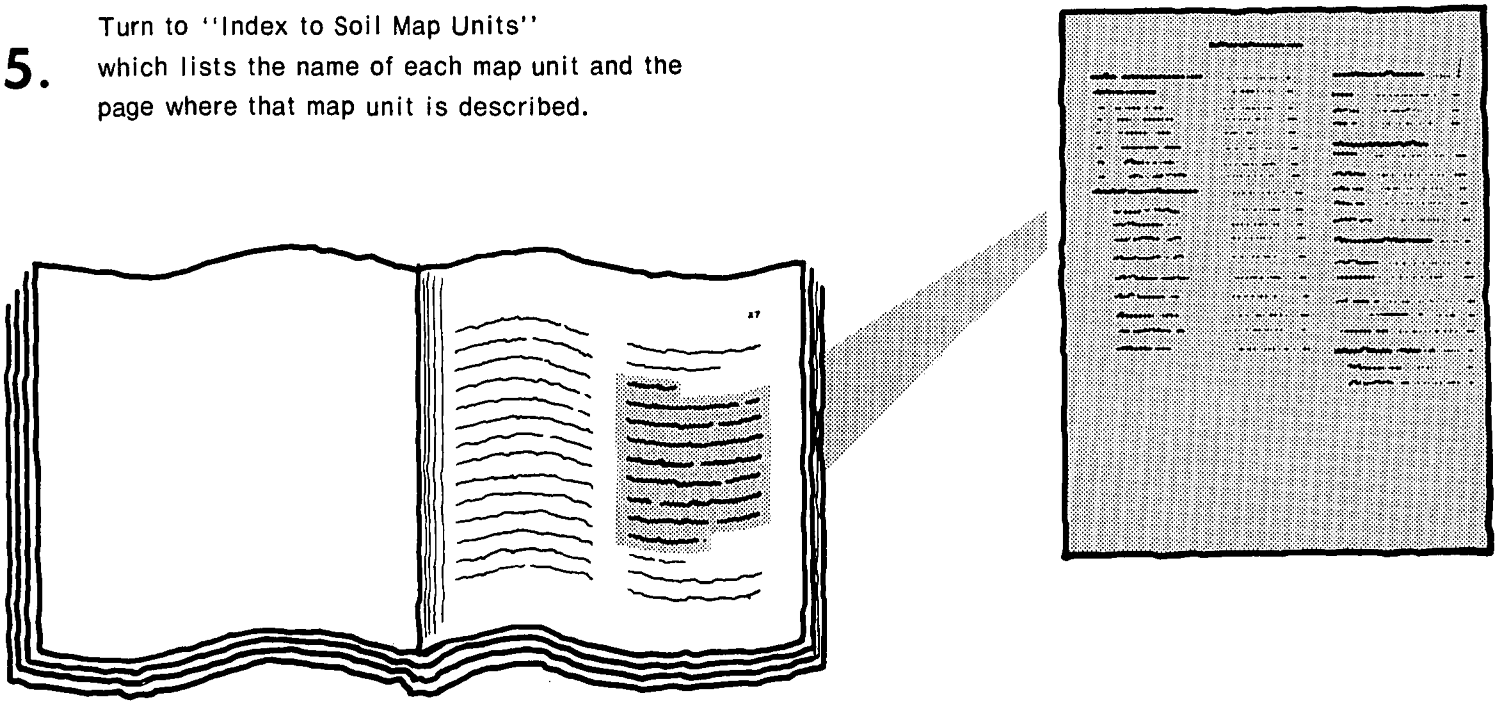


4. List the map unit symbols that are in your area.

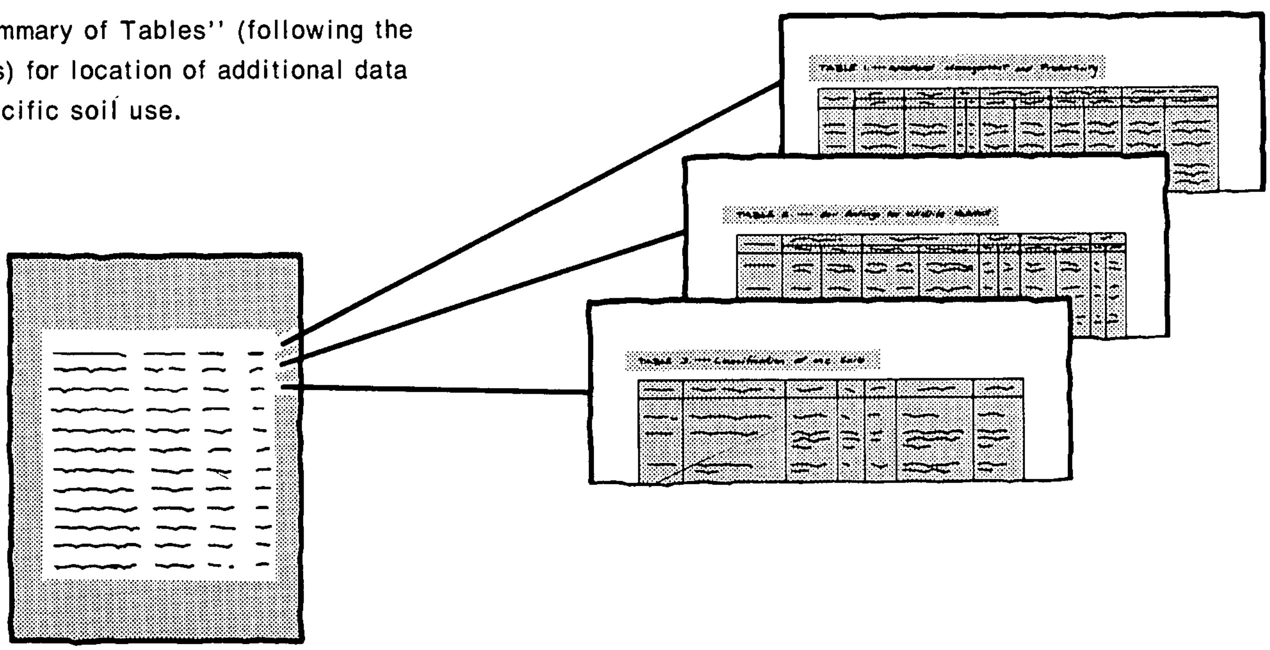


THIS SOIL SURVEY

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



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



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

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

Major fieldwork for this soil survey was performed in the period 1981 to 1984. Soil names and descriptions were approved in 1984. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1984. 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 Pottawatomie County Conservation District. Financial assistance was provided by the Pottawatomie County Commissioner.

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

Cover: An area of Benfield-Florence complex, 3 to 15 percent slopes, used as range.

Contents

Soil Series

Issued December 1987

Index to Map Units

Summary of Tables

Foreword

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

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

John W. Tippie
State Conservationist
Soil Conservation Service

Soil Survey of Pottawatomie County, Kansas

By Marcellus L. Horsch, P. Robert Kutnink, Donald A. Gier,
Bobby D. Tricks, and William A. Wehmueller, Soil Conservation Service

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

General Nature of the County

POTTAWATOMIE COUNTY is in the northeastern part of Kansas (fig. 1). It has a total area of 551,366 acres, or about 861 square miles. Westmoreland is the county seat, and Wamego is the largest town.

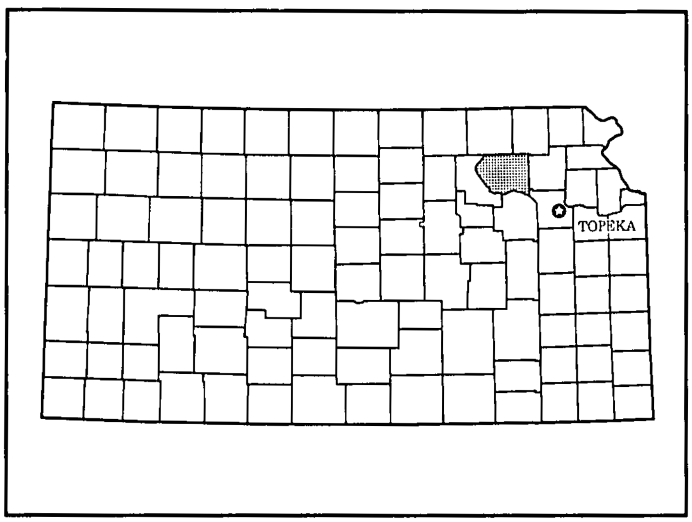


Figure 1.—Location of Pottawatomie County in Kansas.

The eastern part of the county is in the Nebraska and Kansas Loess-Drift Hills major land resource area, and the western part is in the Bluestem Hills major land resource area. The soils in the county generally are deep or moderately deep, are nearly level to moderately sloping, and have a silty, loamy, or clayey subsoil. Elevation ranges from about 910 to 1,555 feet above sea level. Most areas are drained by the Kansas and Big Blue Rivers and their tributaries. Tuttle Creek Reservoir borders the western edge of the county.

Ranching, farming and related services, and industrial production are the main enterprises in the county. Many people are employed by Kansas State University. About 52 percent of the county is range, 34 percent is cropland, 6 percent is woodland, 2 percent is pasture, 2 percent is water, and 4 percent is urban, industrial, or other land. Corn, grain sorghum, wheat, and hay are the principal crops. The major kinds of livestock are cattle and hogs.

Climate

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

The climate of Pottawatomie 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.

Pottawatomie 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 of several weeks are not uncommon during the growing season. A surplus of precipitation often results in muddy fields, which may delay planting and harvesting.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Wamego 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 32.2 degrees F, and the average daily minimum temperature is 21.6 degrees. The lowest temperature on record, which occurred at Wamego on January 4, 1947, is -26 degrees. In summer the average temperature is 77.6 degrees, and the average daily maximum temperature is 89.4 degrees. The highest recorded temperature, which occurred on August 13, 1936, and July 12, 1954, is 114 degrees.

The total annual precipitation is 33.08 inches. Of this, 23.78 inches, or nearly 72 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 16.45 inches. The heaviest recorded 1-day rainfall, which occurred at Wamego on August 13, 1946, is 6.93 inches.

The average seasonal snowfall is 21.5 inches. The highest recorded seasonal snowfall, which occurred during the winter of 1911-1912, is 61 inches. On the average, 23 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 snow cover seldom lasts more than 7 days in succession.

The sun shines about 75 percent of the time possible in summer and about 62 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 11.3 miles per hour, in April. The average annual windspeed is 9.2 miles per hour.

Tornadoes and severe thunderstorms strike occasionally. These storms are usually local in extent and of short duration, so that the risk of damage is small. Hail falls during warm periods. The hailstorms are infrequent, however, and are of local extent. They cause less crop damage in this county than in western Kansas.

Natural Resources

Soil is the most important natural resource in the county. It directly affects such marketable products as livestock and crops.

Other natural resources include limestone, gravel, sand, and water. The limestone is quarried for use as road-building material, concrete aggregate, and agricultural lime. Sand and gravel pits are in or adjacent to the Kansas and Big Blue Rivers. A few pits are in areas of glacial drift on uplands. The county currently has only one oil field. This small field is south of Havensville.

In the uplands, ground water wells generally are low yielding and most farms are served by rural water districts. There are excellent wells in most areas of the bottom land along the Kansas and Big Blue Rivers. Numerous gravity and sprinkler irrigation systems are along these rivers. Most of the irrigation water is drawn from wells. Perennial streams, lakes, ponds, and springs provide surface water for municipal and recreational uses and for livestock and wildlife.

How This Survey Was Made

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

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

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

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

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

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

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

Map Unit Composition

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

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 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-Tully-Benfield Association

Moderately deep and deep, moderately sloping to steep, well drained soils that have a silty or clayey subsoil; 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 61 percent of the county. It is about 25 percent Clime soils, 17 percent Tully soils, 15 percent Benfield soils, and 43 percent minor soils (fig. 2).

The moderately deep Clime soils formed in material weathered from calcareous, clayey shale. These strongly sloping to steep soils are on the upper side slopes. Typically, the surface layer is very dark brown, calcareous silty clay loam about 8 inches thick. The subsoil is calcareous, firm silty clay loam about 8 inches thick. The upper part is very dark grayish brown, and the lower part is grayish brown and dark grayish brown. The substratum is grayish brown, calcareous silty clay loam. Calcareous shale is at a depth of about 26 inches.

The deep Tully soils formed in colluvium and local alluvium. These moderately sloping soils are on foot slopes and the lower side slopes. Typically, the surface layer is black silty clay loam about 13 inches thick. The subsoil is about 47 inches thick. The upper part is very dark grayish brown, firm silty clay loam, and the lower part is very dark grayish brown and dark brown, mottled, firm silty clay.

The moderately deep Benfield soils formed in material weathered from calcareous shale. These moderately sloping soils are on ridgetops and the upper side slopes. Typically, the surface layer is very dark brown silty clay loam about 6 inches thick. The subsoil is about 24 inches thick. The upper part is dark brown, firm silty clay loam, and the lower part is dark brown and reddish brown, mottled, firm silty clay. Calcareous shale is at a depth of about 30 inches.

The minor soils in this association are the Florence, Kennebec, Pawnee, Sogn, Tuttle, and Wymore soils. The cherty, moderately slowly permeable Florence soils are on ridgetops and side slopes. The moderately well drained Kennebec soils are on flood plains along narrow drainageways. The loamy, moderately well drained Pawnee soils are on side slopes. The shallow, somewhat excessively drained Sogn soils are on breaks on ridgetops and the upper side slopes. The steep, stony, somewhat excessively drained Tuttle soils are on side slopes. The moderately well drained Wymore soils are on ridgetops.

About 70 percent of this association is used as range or native hayland. The rest is used as cropland, as tame pasture, as hayland planted to legumes, or as woodland. Maintaining the growth and vigor of the desirable native grasses and controlling brush are the main concerns in managing range. Controlling water erosion and maintaining tilth and fertility are the main concerns in managing cultivated areas.

2. Pawnee-Wymore Association

Deep, nearly level to moderately sloping, moderately well drained soils that have a dominantly silty or clayey subsoil; on uplands

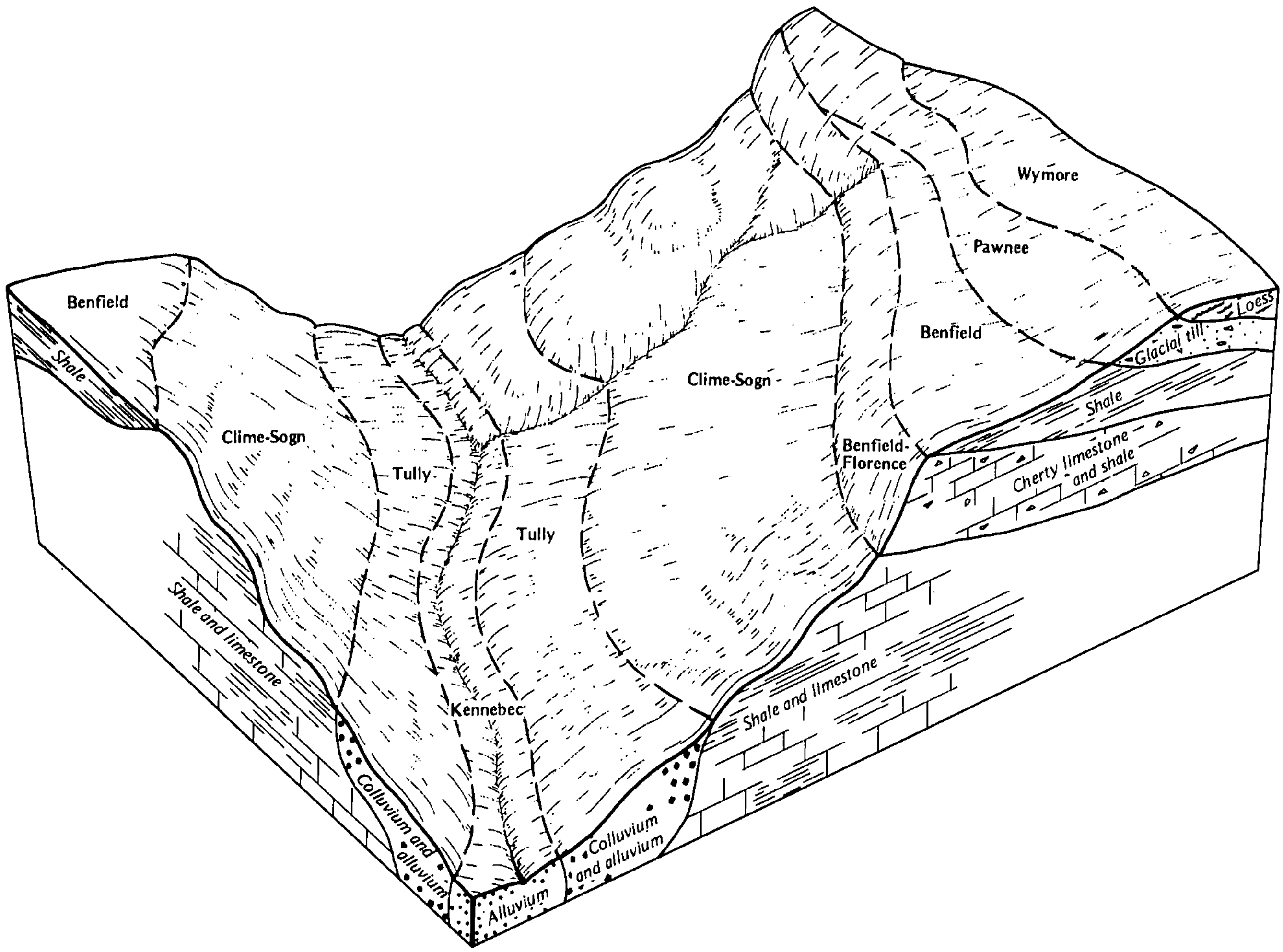


Figure 2.—Pattern of soils and parent material in the Clime-Tully-Benfield association.

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

This association makes up about 11 percent of the county. It is about 46 percent Pawnee soils, 23 percent Wymore soils, and 31 percent minor soils (fig. 3).

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 10 inches thick. The subsoil is about 32 inches thick. The upper part is dark brown, mottled, firm clay loam, and the lower part is dark yellowish brown and yellowish brown, mottled, firm clay. The substratum to a depth of about 60 inches is mixed light olive brown and grayish brown clay loam.

The nearly level to moderately sloping Wymore soils formed in loess on side slopes and broad ridgetops. Typically, the surface layer is very dark brown silty clay loam about 6 inches thick. The subsoil extends to a depth of more than 60 inches. The upper part is very dark brown, firm silty clay loam; the next part is brown, very dark brown, dark grayish brown, and very dark grayish brown, mottled, very firm silty clay; and the lower part is brown and grayish brown, mottled, firm silty clay loam.

The minor soils in this association are the Benfield, Clime, Kennebec, Sogn, and Tully soils. The moderately deep Benfield soils are on ridgetops and the upper side slopes. The moderately deep, calcareous Clime soils are on the upper side slopes. The moderately permeable Kennebec soils are on flood plains along narrow drainageways. The shallow, somewhat excessively drained Sogn soils are on breaks on ridgetops and the upper side slopes. The well drained Tully soils are on foot slopes.

About 60 percent of this association is used for cultivated crops, and the rest is used mainly as range. Wheat, grain sorghum, and soybeans are the main crops. Controlling water erosion and conserving moisture are main concerns in managing cultivated areas. Maintaining the growth and vigor of the desirable grasses is the main concern in managing range.

3. Paxico-Muir-Eudora Association

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

This association is on flood plains and stream terraces along the major rivers and the Tuttle Creek Reservoir. Slopes are 0 to 1 percent.

This association makes up about 7 percent of the county. It is about 18 percent Paxico soils, 16 percent Muir soils, 14 percent Eudora soils, and 52 percent minor soils.

The somewhat poorly drained Paxico soils formed in alluvium on flood plains adjacent to the major river channels and the Tuttle Creek Reservoir. Typically, the surface layer is very dark grayish brown, calcareous silt loam about 9 inches thick. The substratum extends to a depth of more than 60 inches. It is calcareous. The upper part is dark grayish brown and very dark grayish brown, mottled silt loam, and the lower part is dark grayish brown loamy fine sand.

The well drained Muir soils formed in silty alluvium on stream terraces. Typically, the surface layer is very dark brown silt loam about 5 inches thick. The subsurface layer also is very dark brown silt loam. It is about 17 inches thick. The subsoil is dark grayish brown, friable silt loam about 22 inches thick. The substratum to a depth of about 60 inches is dark brown silt loam.

The well drained Eudora soils formed in silty alluvium on stream terraces. Typically, the surface layer is very dark grayish brown silt loam about 6 inches thick. The subsurface layer also is very dark grayish brown silt loam. It is about 5 inches thick. The subsoil is dark brown, friable silt loam about 4 inches thick. The upper part of the substratum is brown silt loam. The lower part to a depth of about 60 inches is brown very fine sandy loam.

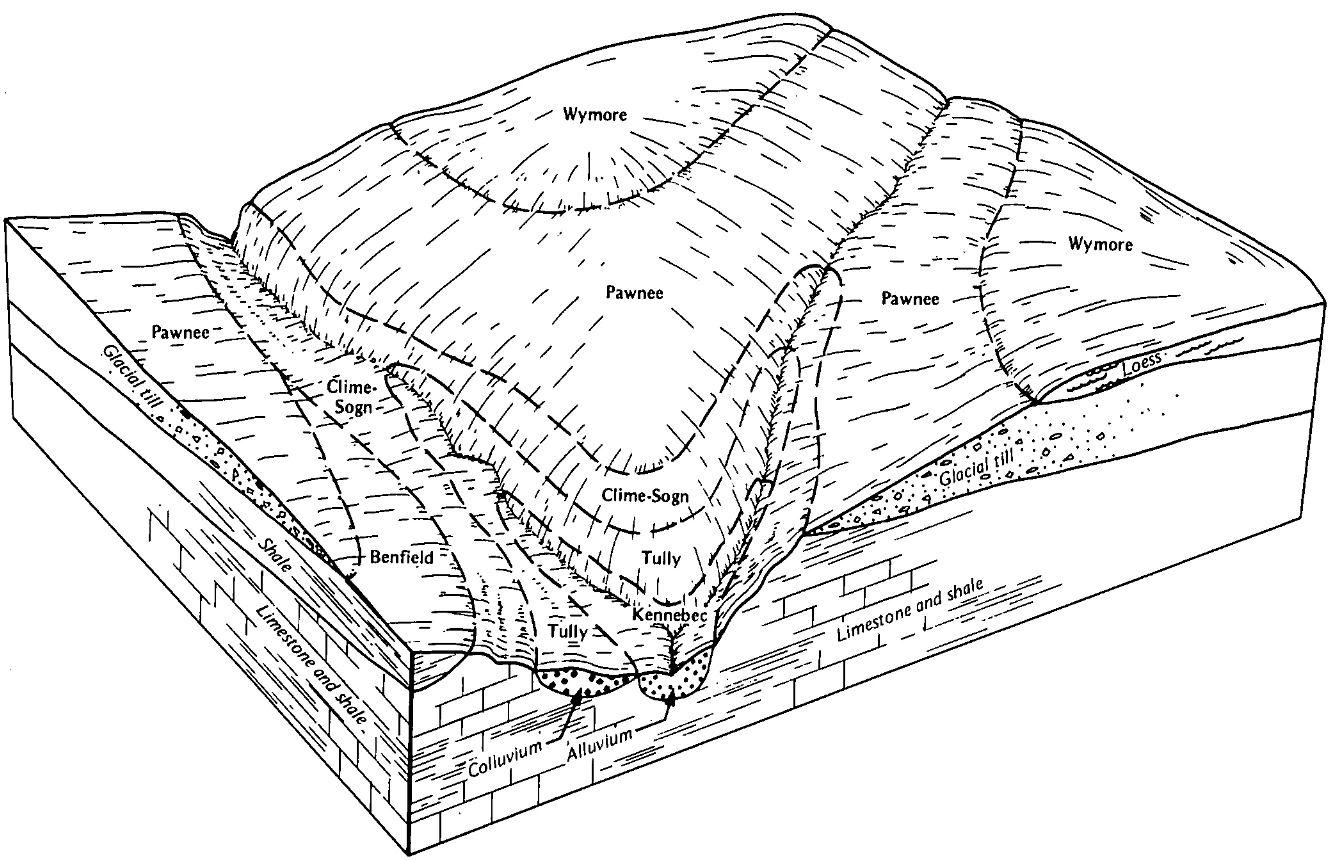


Figure 3.—Pattern of soils and parent material in the Pawnee-Wymore association.

The minor soils in this association are the Haynie, Kimo, Sarpy, and Zook soils. The loamy, moderately well drained Haynie soils are on flood plains. The somewhat poorly drained Kimo soils are in slight depressions on low stream terraces. The sandy Sarpy soils are on flood plains along the major rivers. The poorly drained Zook soils are on stream terraces.

About 80 percent of this association is used for cultivated crops or hay meadows, and the rest is used mainly as woodland or range. Corn, grain sorghum, wheat, alfalfa, and soybeans are the main crops. Maintaining tilth and fertility is the main concern in managing cultivated areas. Maintaining the growth and vigor of the desirable grasses is the main concern in managing range.

4. Kennebec-Chase-Wabash Association

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

This association is on flood plains and stream terraces along creeks and streams. Slopes range from 0 to 2 percent.

This association makes up about 7 percent of the county. It is about 40 percent Kennebec soils, 26 percent Chase soils, 21 percent Wabash soils, and 13 percent minor soils.

The moderately well drained Kennebec soils formed in alluvium on flood plains. Typically, the surface layer is very dark brown silt loam about 6 inches thick. The subsurface layer is black silt loam about 36 inches thick. The subsoil is very dark grayish brown, friable silt loam about 12 inches thick. The substratum to a depth of about 60 inches is very dark grayish brown silt loam.

The somewhat poorly drained Chase soils formed in alluvium on stream terraces. Typically, the surface layer is very dark brown silty clay loam about 7 inches thick. The subsurface layer also is very dark brown silty clay loam. It is about 9 inches thick. The subsoil is about 32 inches thick. The upper part is very dark brown, firm silty clay loam; the next part is very dark brown, mottled, very firm silty clay; and the lower part is very dark grayish brown, mottled, firm silty clay. The substratum to a depth of about 60 inches is dark brown, mottled silty clay loam.

The very poorly drained Wabash soils formed in clayey alluvium on flood plains. Typically, the surface layer is very dark gray silty clay about 5 inches thick. The subsurface layer also is very dark gray silty clay. It is about 13 inches thick. The subsoil to a depth of more than 60 inches is very firm, mottled silty clay. The upper part is very dark gray, the next part is dark gray, and the lower part is dark grayish brown.

The minor soils in this association are the well drained Reading and Tully soils. Reading soils are on stream terraces. Tully soils are on foot slopes.

Nearly all areas of this association are used for cultivated crops or hay. A few small areas are used as woodland. Corn, sorghum, soybeans, alfalfa, and small grain are the main crops. Controlling flooding, improving surface drainage, and maintaining fertility and tilth are the main concerns in managing cultivated areas.

5. Wamego-Elmont Association

Moderately deep and deep, moderately sloping to moderately steep, well drained soils that have a silty subsoil; on uplands

This association is on side slopes, foot slopes, and narrow ridgetops dissected by intermittent drainageways. Slopes range from 3 to 20 percent.

This association makes up about 7 percent of the county. It is about 42 percent Wamego soils, 18 percent Elmont soils, and 40 percent minor soils (fig. 4).

The moderately deep Wamego soils formed in material weathered from silty shale. These moderately sloping to moderately steep soils are on ridgetops and side slopes. Typically, the surface layer is very dark gray silt loam about 6 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 4 inches thick. The subsoil is friable silty clay loam about 17 inches thick. The upper part is dark brown and has some fine sandstone fragments. The lower part is yellowish brown and has many fine sandstone and shale fragments. Pale brown and yellowish brown shale is at a depth of about 27 inches.

The deep Elmont soils formed in material weathered from noncalcareous, micaceous, silty shale. These moderately sloping soils are on side slopes and foot slopes. Typically, the surface layer is very dark grayish brown silty clay loam about 5 inches thick. The subsurface layer also is very dark grayish brown silty clay loam about 5 inches thick. The subsoil is firm silty clay loam about 40 inches thick. The upper part is dark brown and mottled, the next part is brown and mottled, and the lower part is dark yellowish brown and yellowish brown. Sandy and silty shale is at a depth of about 50 inches.

The minor soils in this association are the Clime, Kennebec, Pawnee, Sogn, Tully, and Wymore soils. The calcareous Clime soils are on the upper side slopes. The moderately well drained Kennebec soils are on flood plains along narrow drainageways. The deep, loamy Pawnee soils are on ridgetops and side slopes. The shallow, somewhat excessively drained Sogn soils are on breaks on ridgetops and the upper side slopes. The deep Tully soils are on foot slopes. The moderately well drained Wymore soils are on ridgetops and side slopes.

This association is used mainly for range or for cultivated crops. Some areas are used for hay and pasture. A few small areas support native oak and hickory trees. Controlling water erosion and maintaining fertility are the main concerns in managing cultivated

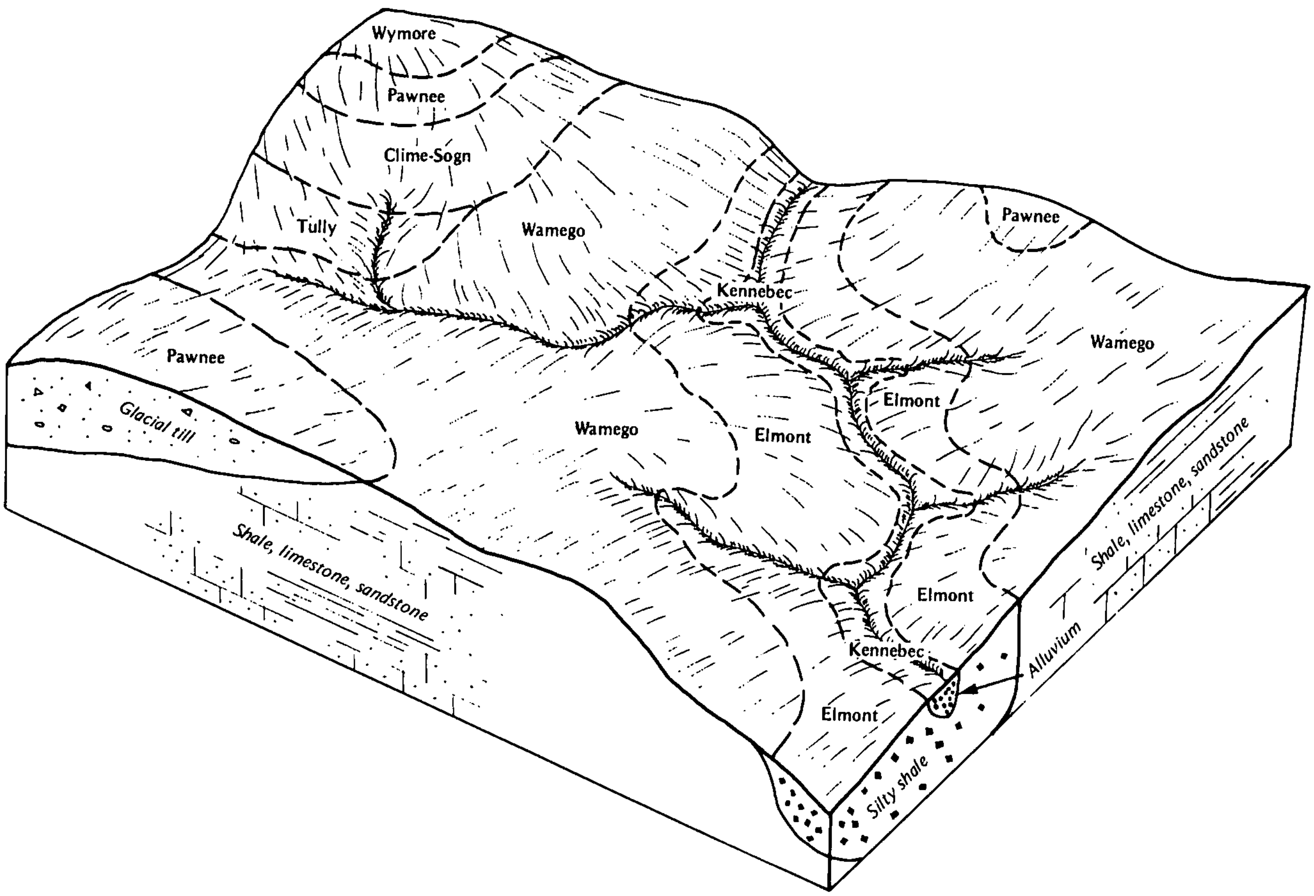


Figure 4.—Pattern of soils and parent material in the Wamego-Elmont association.

areas. Maintaining the growth and vigor of the desirable grasses is the main concern in managing range.

6. Morrill-Ortello Association

Deep, moderately sloping to moderately steep, well drained soils that have a loamy subsoil; on uplands

This association is on side slopes, foot slopes, and narrow ridgetops that are dissected by drainageways and creeks. Slopes range from 3 to 20 percent.

This association makes up about 5 percent of the county. It is about 42 percent Morrill soils, 19 percent Ortello soils, and 39 percent minor soils (fig. 5).

The moderately sloping to moderately steep Morrill soils formed in loamy till or outwash on ridgetops and side slopes. Typically, the surface layer is very dark brown loam about 10 inches thick. The subsoil is about 24 inches thick. The upper part is dark reddish brown, friable loam; the next part is reddish brown, firm clay loam; and the lower part is yellowish red, friable clay loam. The substratum to a depth of about 60 inches is yellowish red clay loam.

The moderately sloping and strongly sloping Ortello soils formed in loamy and sandy eolian deposits on side slopes and foot slopes. Typically, the surface layer is very dark grayish brown fine sandy loam about 5 inches thick. The subsurface layer is very dark brown fine sandy loam about 5 inches thick. The next layer is very dark grayish brown fine sandy loam about 9 inches thick. The subsoil is dark yellowish brown, friable fine sandy loam about 8 inches thick. The substratum to a depth of about 60 inches is dark yellowish brown loamy fine sand.

The minor soils in this association are the Sharpsburg, Thurman, Wann, and Wymore Variant soils. The silty, moderately well drained Sharpsburg soils are on ridgetops and the upper side slopes. The sandy, somewhat excessively drained Thurman soils are on foot slopes below the Ortello soils. The somewhat poorly drained Wann soils are on flood plains along narrow drainageways. The silty, moderately well drained Wymore Variant soils are on ridgetops and side slopes.

About 60 percent of this association is used as range, hayland, or pasture, and the rest is used mainly as

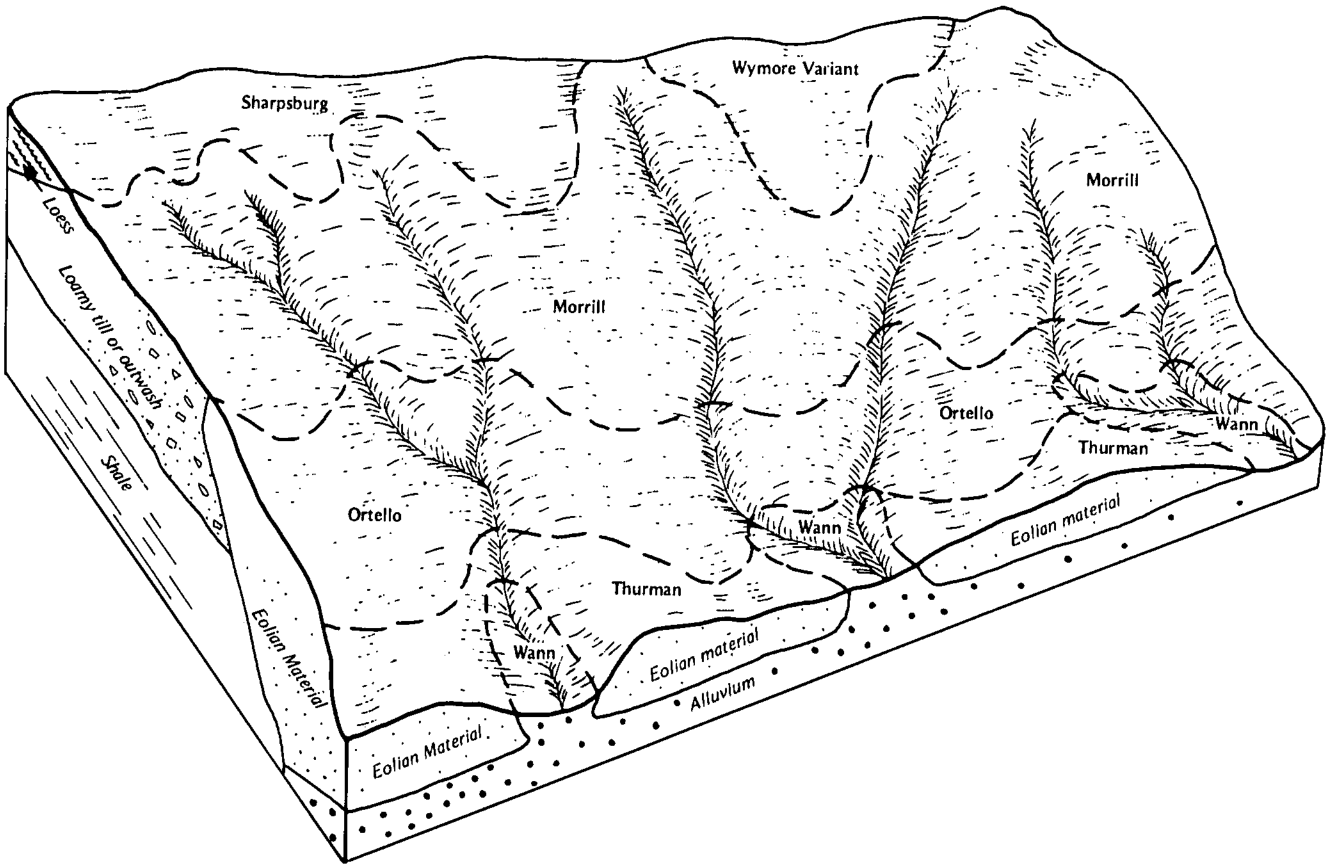


Figure 5.—Pattern of soils and parent material in the Morrill-Ortello association.

cropland. Maintaining the growth and vigor of the desirable native grasses and controlling brush are main concerns in managing range. Controlling water erosion and soil blowing and maintaining fertility are the main concerns in managing cultivated areas.

7. Pawnee-Morrill Association

Deep, moderately sloping to moderately steep, moderately well drained and well drained soils that have a clayey or loamy subsoil; on uplands

This association is on side slopes and narrow ridgetops that are dissected by drainageways and creeks. Slopes range from 3 to 20 percent.

This association makes up about 2 percent of the county. It is about 45 percent Pawnee soils, 43 percent Morrill soils, and 12 percent minor soils.

The moderately well drained Pawnee soils formed in glacial till. These moderately sloping soils are on ridgetops and side slopes. Typically, the surface layer is very dark brown clay loam about 10 inches thick. The subsoil is about 32 inches thick. The upper part is dark brown, mottled, firm clay loam, and the lower part is dark yellowish brown and yellowish brown, mottled, firm clay. The substratum to a depth of about 60 inches is mixed light olive brown and grayish brown clay loam.

The well drained Morrill soils formed in loamy till or outwash sediments. These moderately sloping to moderately steep soils are on ridgetops and side slopes. Typically, the surface layer is very dark brown loam about 10 inches thick. The subsoil is about 24 inches thick. The upper part is dark reddish brown, friable loam; the next part is reddish brown, firm clay loam; and the lower part is yellowish red, friable clay loam. The substratum to a depth of about 60 inches is yellowish red clay loam.

The minor soils in this association are the Clime, Sogn, and Wamego soils. The silty, moderately deep, calcareous Clime soils are on the upper side slopes. The shallow, somewhat excessively drained Sogn soils are on breaks on ridgetops and the upper side slopes. The silty, moderately deep Wamego soils are on ridgetops and side slopes.

About 60 percent of this association is used as range or native hayland. The rest is used as cropland, as tame pasture, as hayland planted to legumes, or as woodland. Maintaining the growth and vigor of the desirable native grasses and controlling brush are the main concerns in managing range. Controlling water erosion and maintaining tilth and fertility are the main concerns in managing 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 in 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. Eudora-Kimo complex is an example.

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

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

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

Bd—Benfield silty clay loam, 2 to 5 percent slopes. This moderately deep, moderately sloping, well drained soil is on narrow ridgetops. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is very dark brown silty clay loam about 6 inches thick. The subsoil is about 24 inches thick. The upper part is dark brown, firm silty clay loam, and the lower part is dark brown and reddish brown, mottled, firm silty clay. Calcareous shale is at a depth of about 30 inches. In areas where the surface layer and subsoil have been mixed by tillage, the surface layer is more clayey. In some places the depth to shale is more than 40 inches. In other places the soil is calcareous throughout.

Included with this soil in mapping are small areas of Pawnee, Sogn, and Wymore soils. The deep Pawnee and Wymore soils are on ridgetops above the Benfield soil. The shallow Sogn soils are on breaks and side slopes below the Benfield soil. Included soils make up about 15 percent of the map unit.

Permeability is slow in the Benfield soil, and runoff is medium. Available water capacity is moderate. Organic matter content also is moderate, and natural fertility is medium. The surface layer is slightly acid. It is friable and can be easily tilled. The shrink-swell potential is high in the subsoil. Root development is restricted below a depth of about 30 inches.

About 70 percent of the acreage is used as range. The rest is used for cultivated crops, pasture, or native hay. This soil has medium potential for grain sorghum, wheat, range, sewage lagoons, and dwellings without basements. It has low potential for septic tank absorption fields and for dwellings with basements.

If cultivated crops are grown, water erosion is a hazard and the restricted rooting depth and droughtiness are limitations. 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 long enough and smooth enough for contour farming and terracing. 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 restricted rooting depth and the droughtiness are limitations in the areas used as range. The native vegetation is dominantly big bluestem, little bluestem, indiangrass, and switchgrass. If the range is heavily used throughout the growing season, these grasses are replaced by less desirable plants, such as tall dropseed, Baldwin ironweed, and western ragweed.

Water erosion is a hazard if the range is overgrazed. An adequate plant cover helps to prevent excessive soil loss. Grazing when the soil is too wet causes surface compaction, reduces the rate of water infiltration, and increases the runoff rate. A proper stocking rate, a scheduled deferment of grazing during the growing season, a uniform distribution of grazing, and restricted use during wet periods help to keep the range productive.

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

Bf—Benfield-Florence complex, 3 to 15 percent slopes. These well drained soils are on uplands. Scattered coarse chert fragments are on the surface in most areas. The moderately deep, moderately sloping Benfield soil is on ridgetops and side slopes. The deep, strongly sloping Florence soil is on shoulder slopes and breaks. Individual areas are irregular in shape and range from 10 to 100 acres in size. They are about 70 percent Benfield soil and 15 percent Florence soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the Benfield soil has a surface layer of very dark brown silty clay loam about 6 inches thick. The subsoil is about 24 inches thick. The upper part is dark brown, firm silty clay loam, and the lower part is dark brown and reddish brown, mottled, firm silty clay. Calcareous shale is at a depth of about 30 inches. In some areas the surface layer is silty clay. In some places the depth to shale is more than 40 inches. In other places the soil is calcareous throughout.

Typically, the Florence soil has a surface layer of very dark brown cherty silty clay loam about 6 inches thick (fig. 6). The subsurface layer is very dark brown very cherty silty clay loam about 8 inches thick. The subsoil is dark reddish brown, firm very cherty silty clay about 28 inches thick. Cherty limestone is at a depth of about 42 inches. In some areas the depth to bedrock is less than 40 inches.

Included with these soils in mapping are small areas of Pawnee, Sogn, Tully, and Wymore soils. The moderately well drained Pawnee and Wymore soils are on ridgetops. The shallow Sogn soils are near breaks on some ridgetops. The deep Tully soils are on foot slopes. Included soils make up about 15 percent of the map unit.

Permeability is slow in the Benfield soil and moderately slow in the Florence soil. Available water capacity is moderate in the Benfield soil and low in the Florence soil. Runoff is medium on the Benfield soil and rapid on the Florence soil. Organic matter content is moderate in both soils. Natural fertility is medium in the Benfield soil and low in the Florence soil. Root development is restricted below a depth of about 30 inches in the Benfield soil and 42 inches in the Florence soil. The shrink-swell potential is high in the subsoil of the Benfield soil and moderate throughout the Florence soil.

Most of the acreage is used as range. Some areas are harvested for hay. Because of the hazard of water erosion on both soils and the cherty surface layer in the Florence soil, these soils have very low potential for cultivated crops. They have medium potential for range and for sewage lagoons. The potential for septic tank absorption fields is very low on the Benfield soil and low on the Florence soil. Both soils have low potential for dwellings.

In the areas used for range, the main limitations are the droughtiness of both soils, the restricted rooting depth in the Benfield soil, and the invasion of woody plants on the Florence soil. The native vegetation is dominantly big bluestem, little bluestem, and indiangrass. If the range is heavily used throughout the growing season, these grasses are replaced by less desirable plants, such as tall dropseed, Baldwin ironweed, and western ragweed.

Water erosion is a hazard if the range is overgrazed. An adequate plant cover helps to prevent excessive soil loss. Grazing during excessively wet periods causes surface compaction in areas of the Benfield soil. As a result of the compaction, the runoff rate is increased. A proper stocking rate, a scheduled deferment of grazing during the growing season, a uniform distribution of grazing, restricted use during wet periods, and brush control help to keep the range productive.

Figure 6.—Profile of Florence cherty silty clay loam. The chert fragments reduce the available water capacity. Depth is marked in feet.

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

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 10 to several hundred acres in size.

Typically, the surface layer is very dark brown silty clay loam about 7 inches thick. The subsurface layer also is very dark brown silty clay loam. It is about 9 inches thick. The subsoil is about 32 inches thick. The upper part is very dark brown, firm silty clay loam; the next part is very dark brown, mottled, very firm silty clay; and the lower part is very dark grayish brown, mottled, firm silty clay. The substratum to a depth of about 60 inches is dark brown, mottled silty clay loam. In some places the surface layer is silty clay. In other places the upper part of the subsoil is not mottled.

Included with this soil in mapping are small areas of Kennebec, Reading, and Wabash soils. The moderately well drained Kennebec soils and the very poorly drained Wabash soils are on flood plains. The well drained Reading soils are on the higher terraces. Included soils make up about 15 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 is moderate. The surface layer is neutral. It is friable and can be easily tilled. 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 early spring.

Nearly all of the acreage is used for cultivated crops. Some small areas are wooded. This soil has high potential for grain sorghum, soybeans, and wheat and very high potential for range. It has very low potential for septic tank absorption fields and dwellings with basements. The potential for dwellings without basements is low, and the potential for sewage lagoons is high.

If cultivated crops are grown, flooding is a hazard and wetness is a limitation. In some years of above average rainfall, the wetness delays planting and tillage. Open surface drains help to remove excess water, and timely tillage minimizes surface compaction. Crop rotation helps to control weeds, plant diseases, and insect carry-over. 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.

Trees and shrubs grow along the banks of many of the streams. They can be used for wood products. They stabilize the streambanks, beautify the landscape, and add vegetative diversity. By providing food and cover, they also attract woodland wildlife species. This soil is well suited to trees. The equipment limitation and seedling mortality are moderate. Harvesting equipment can be used only during dry periods. Thinning and selective harvesting improve the stand. Tree seedlings and cuttings survive and grow well if competing plants are controlled.

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

Cm—Clime silty clay loam, 20 to 40 percent slopes, stony. This moderately deep, steep, well drained soil is on upland breaks and side slopes. Numerous limestone rocks are on the surface. They 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 irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is very dark brown, calcareous silty clay loam about 6 inches thick. The subsoil is calcareous, firm silty clay loam about 8 inches thick. The upper part is very dark grayish brown, and the lower part is grayish brown and dark grayish brown. The substratum is grayish brown, calcareous silty clay loam. Calcareous shale is at a depth of about 26 inches. In some places the depth to shale is less than 20 inches. In other places the soil is noncalcareous.

Included with this soil in mapping are small areas of Tully and Sogn soils and rock outcrops. The deep Tully soils are on foot slopes. The shallow Sogn soils are on ridgetops. The rock outcrops are on breaks below the ridgetops. Included areas make up about 10 percent of the map unit.

Permeability is slow in the Clime soil, and runoff is rapid. Available water capacity is low. Organic matter content is moderate, and natural fertility is medium. The surface layer is moderately alkaline. The shrink-swell potential is moderate in the subsoil. Root development is restricted below a depth of about 26 inches.

Nearly all of the acreage is used as range. Some of the steeper slopes are heavily wooded. Because of the hazard of water erosion, the restricted rooting depth, the slope, droughtiness, and the surface stones, this soil has very low potential for cultivated crops. It also has very low potential for range and for septic tank absorption fields. The potential for dwellings and sewage lagoons is low.

The restricted rooting depth, the invasion of woody plants, the droughtiness, the slope, and the surface stones are limitations in the areas used as range. The native vegetation is dominantly big bluestem, little bluestem, and indiangrass. If the range is heavily used throughout the growing season, these grasses are replaced by less desirable plants, such as annual bromegrass and annual broomweed.

Water erosion is a hazard if the range is overgrazed. An adequate plant cover helps to prevent excessive soil loss. Properly distributed salting and watering facilities and fences help to achieve a more uniform distribution of grazing. Grazing when the soil is too wet causes surface compaction, reduces the rate of water infiltration, and increases the runoff rate. A proper stocking rate, a scheduled deferment of grazing during the growing season, a uniform distribution of grazing, restricted use during wet periods, and brush control help to keep the range productive.

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 strongly sloping and moderately steep soils are on uplands. The moderately deep, well drained Clime soil is on side slopes. The shallow, somewhat excessively drained Sogn soil is on ridgetops. Individual areas are irregular in shape and range from 5 to several hundred acres in size. They are about 70 percent Clime soil and 15 percent Sogn soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the Clime soil has a surface layer of very dark brown, calcareous silty clay loam about 8 inches thick (fig. 7). The subsoil is calcareous, firm silty clay loam about 8 inches thick. The upper part is very dark grayish brown, and the lower part is grayish brown and dark grayish brown. The substratum is grayish brown, calcareous silty clay loam. Calcareous shale is at a depth of about 26 inches. In some places the soil is noncalcareous throughout and has a redder subsoil. In other places it has numerous chert fragments throughout.

Typically, the Sogn soil has a surface layer of very dark brown silty clay loam about 14 inches thick. Limestone bedrock is at a depth of about 14 inches.

Included with these soils in mapping are small areas of Kennebec, Pawnee, and Tully soils and limestone outcrops. Kennebec, Pawnee, and Tully soils are more than 40 inches deep over bedrock. Kennebec soils are along small drainageways. Pawnee soils are on ridgetops. Tully soils are on foot slopes. The limestone outcrops occur as bands of bedrock on ledges. Included areas make up about 15 percent of the map unit.

Permeability is slow in the Clime soil and moderate in the Sogn soil. Available water capacity is low in both soils. Runoff is rapid. 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 throughout the Sogn soil. Root development is restricted below a depth of about 26 inches in the Clime soil and 14 inches in the Sogn soil.

Nearly all of the acreage is used as range. Some small areas are wooded. Because of the hazard of water erosion, the restricted rooting depth, the slope, and droughtiness, these soils have very low potential for cultivated crops. They also have very low potential for range. The potential for dwellings with basements is very low on the Sogn soil and low on the Clime soil. The potential for dwellings without basements is low on the Clime soil and medium on the Sogn soil. Both soils have very low potential for septic tank absorption fields and low potential for sewage lagoons.

The restricted rooting depth, the invasion of woody plants, and the droughtiness are limitations in the areas used as range. The native vegetation is dominantly little bluestem, big bluestem, and sideoats grama. Sideoats grama is more common on the Sogn soil than on the

Figure 7.—Profile of Clime silty clay loam, which has a dark surface layer. Depth is marked in feet.

Clime soil. If the range is heavily used throughout the growing season, the dominant native grasses are replaced by less desirable plants, such as annual bromegrass and annual broomweed.

Water erosion is a hazard if the range is overgrazed. An adequate plant cover helps to prevent excessive soil loss. Properly distributed salting and watering facilities and fences help to achieve a more uniform distribution of grazing. Grazing when the soil is too wet causes surface compaction, reduces the rate of water infiltration, and increases the runoff rate. A proper stocking rate, a scheduled deferment of grazing during the growing season, a uniform distribution of grazing, restricted use during wet periods, and brush control help to keep the range productive.

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

Em—Elmont silty clay 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 10 to several hundred acres in size.

Typically, the surface layer is very dark grayish brown silty clay loam about 5 inches thick. The subsurface layer also is very dark grayish brown silty clay loam about 5 inches thick. The subsoil is firm silty clay loam about 40 inches thick. The upper part is dark brown and mottled, the next part is brown and mottled, and the lower part is dark yellowish brown and yellowish brown. Sandy and silty shale is at a depth of about 50 inches. In some places the depth to shale is less than 40 inches, and in other places it is more than 60 inches.

Included with this soil in mapping are small areas of Pawnee and Wamego soils. Pawnee soils are on the upper side slopes. They are more clayey than the Elmont soil. The moderately deep Wamego soils are on ridgetops and the upper side slopes. Included soils make up about 15 percent of the map unit.

Permeability is moderately slow in the Elmont soil, and runoff is medium. Available water capacity is high. Organic matter content is moderate, and natural fertility is medium. The surface layer is neutral. It is friable and can be easily tilled. The shrink-swell potential is moderate in the subsoil. Root development is restricted below a depth of about 50 inches.

Nearly all of the acreage is used for cultivated crops. The rest supports native grass that is used for hay. This soil has medium potential for grain sorghum, wheat, range, and sewage lagoons. It has low potential for septic tank absorption fields. The potential for dwellings is high.

Water erosion is a hazard if cultivated crops are grown. Reducing the number of tillage operations, planting winter cover crops, 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 surface crusting, and increase the rate of water infiltration.

The invasion of woody plants is a limitation if this soil is used for range. The native vegetation is dominantly big bluestem, indiangrass, little bluestem, and switchgrass. If the range is heavily used throughout the growing season, these grasses are replaced by less desirable plants, such as tall dropseed, Baldwin ironweed, and western ragweed.

Water erosion is a hazard if the range is overgrazed. An adequate plant cover helps to prevent excessive soil loss. Grazing when the soil is too wet causes surface compaction, reduces the rate of water infiltration, and increases the runoff rate. A proper stocking rate, a scheduled deferment of grazing during the growing season, a uniform distribution of grazing, restricted use during wet periods, and brush control help to keep the range productive.

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

Eo—Elmont silty clay loam, 3 to 7 percent slopes, eroded. This deep, moderately sloping, well drained soil is on side slopes and foot slopes. In places gullies or gully scars are common. Individual areas are irregular in shape and range from 10 to 50 acres in size.

Typically, the surface layer is dark brown silty clay loam about 5 inches thick. The subsoil is firm silty clay loam about 42 inches thick. The upper part is dark brown and mottled, the next part is brown and mottled, and the lower part is dark yellowish brown and yellowish brown. Sandy and silty shale is at a depth of about 47 inches. In some places the depth to shale is less than 40 inches, and in other places it is more than 60 inches.

Included with this soil in mapping are small areas of Pawnee and Wamego soils and small areas of soils that have fragments of soft shale and fine grained sandstone in the substratum. Pawnee soils are on the upper side slopes. They are more clayey than the Elmont soil. The moderately deep Wamego soils are on ridgetops and the upper side slopes. Included soils make up about 20 percent of the map unit.

Permeability is moderately slow in the Elmont soil, and runoff is medium. Available water capacity and organic matter content are moderate. Natural fertility is medium. The surface layer is neutral. It is friable and can be easily tilled. The shrink-swell potential is moderate in the subsoil. Root development is restricted below a depth of about 50 inches.

Most areas have been reseeded to grass or have reverted to grassland. The rest are used for cultivated crops. This soil has medium potential for grain sorghum, wheat, range, and sewage lagoons. It has low potential for septic tank absorption fields. The potential for dwellings is high.

Further water erosion is a hazard if cultivated crops are grown. Reducing the number of tillage operations, planting winter cover crops, 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 surface crusting, and increase the rate of water infiltration.

The invasion of woody plants is a limitation in the areas used as range. The native vegetation is dominantly big bluestem, indiangrass, little bluestem, and switchgrass. If the range is heavily used throughout the growing season, these grasses are replaced by less desirable plants, such as tall dropseed, Baldwin ironweed, and western ragweed.

Further water erosion is a hazard if the range is overgrazed. An adequate plant cover helps to prevent excessive soil loss. Grazing when the soil is too wet causes surface compaction, reduces the rate of water infiltration, and increases the runoff rate. A proper stocking rate, a scheduled deferment of grazing during the growing season, a uniform distribution of grazing, restricted use during wet periods, and brush control help to keep the range productive.

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 major rivers. It is subject to rare flooding. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 6 inches thick. The subsurface layer also is very dark grayish brown silt loam. It is about 5 inches thick. The subsoil is dark brown, friable silt loam about 4 inches thick. The upper part of the substratum is brown silt loam. The lower part to a depth of about 60 inches is brown very fine sandy loam. In some places layers of sand are below a depth of 20 inches. In other places the soil is silt loam throughout.

Included with this soil in mapping are small areas of Haynie and Kimo soils. The calcareous Haynie soils are in positions on the landscape similar to those of the Eudora soil. Kimo soils are more clayey than the Eudora soil. They are in the lower areas. Included soils make up about 10 percent of the map unit.

Permeability is moderate in the Eudora soil, and runoff is slow. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is slightly acid. It is friable and can be easily tilled. The shrink-swell potential is low in the subsoil.

Nearly all of the acreage is used for cultivated crops. Some small areas are wooded. This soil has very high potential for grain sorghum, soybeans, wheat, and range. It has low potential for septic tank absorption fields and medium potential for dwellings and sewage lagoons.

No major hazards or limitations affect the use of this soil for cultivated crops. 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.

Trees and shrubs grow along the banks of many of the streams. They can be used for wood products. They stabilize the streambanks, beautify the landscape, and add vegetative diversity. By providing food and cover, they also attract woodland wildlife species. This soil is well suited to trees. Plant competition is moderate. Seedlings and cuttings survive and grow well if competing plants are controlled. Thinning and selective harvesting improve the stand.

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

Ex—Eudora-Kimo complex. These deep, nearly level soils are on stream terraces along the major rivers. They are subject to rare flooding. The well drained Eudora soil is in plane areas, and the somewhat poorly drained Kimo soil is in slight depressions (fig. 8). Individual areas are irregular in shape and range from 10 to 50 acres in size. They are about 55 percent Eudora soil and 30 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 very dark grayish brown silt loam about 6 inches thick. The subsurface layer also is very dark grayish brown silt loam. It is about 5 inches thick. The subsoil is dark brown, friable silt loam about 4 inches thick. The upper part of the substratum is brown silt loam. The lower part to a depth of about 60 inches is brown very fine sandy loam. In some places layers of sand are below a depth of 20 inches. In other places the soil is silt loam throughout.

Typically, the Kimo soil has a surface layer of black silty clay about 9 inches thick. The subsurface layer is about 13 inches thick. It is very dark grayish brown silty clay in the upper part and very dark grayish brown, mottled, calcareous silty clay loam in the lower part. The substratum to a depth of about 60 inches is very dark grayish brown and dark grayish brown, mottled, calcareous silt loam. In some areas the depth to silt loam is less than 20 inches.

Included with these soils in mapping are small areas of Haynie soils on small mounds. These included soils do not have a dark surface layer. They make up about 15 percent of the map unit.

Permeability is moderate in the Eudora soil. It is slow in the upper part of the Kimo soil and moderate in the lower part. Runoff is slow on both soils. Available water capacity is high. Organic matter content is moderate, and natural fertility is medium. The surface layer of the

Figure 8.—An area of the Eudora-Kimo complex. The Eudora soil is in the light colored areas, and the Kimo soil is in the dark areas.

Eudora soil is slightly acid. It is friable and can be easily tilled. The surface layer of the Kimo soil is slightly acid in the upper part and neutral in the lower part. It is firm, and tilth is poor. The shrink-swell potential is low in the Eudora soil. It is high in the upper part of the Kimo soil and low in the lower part. 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. Some small areas are wooded. These soils have very high potential for grain sorghum, soybeans, wheat, and range. They have low potential for septic tank absorption fields and medium potential for dwellings without basements. The Eudora soil has medium potential and the Kimo soil low potential for dwellings with basements and for sewage lagoons.

If cultivated crops are grown, flooding is a hazard on both soils, soil blowing is a hazard on the Eudora soil, and the wetness of the Kimo soil is a limitation. The flooding and the wetness can delay spring planting and tillage. If the soils are tilled when they are too wet, surface compaction is a problem. It can be minimized by timely tillage. 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.

These soils are well suited to trees. Plant competion is moderate on the Eudora soil, and the equipment limitation and seedling mortality are moderate on the Kimo soil. Thinning and selective harvesting improve the stand. Seedlings and cuttings survive and grow well if competing plants are controlled.

The land capability classification is IIw. The range site assigned to the Eudora soil is Loamy Lowland, and that assigned to the Kimo soil is Clay Lowland.

Gm—Gymer silty clay loam, 3 to 8 percent slopes. This deep, moderately sloping, well drained soil is on concave foot slopes on the sides of valleys along the major rivers. Individual areas are elongated or irregularly shaped and range from 5 to 40 acres in size.

Typically, the surface layer is very dark brown silty clay loam about 6 inches thick. The subsurface layer is dark brown silty clay loam about 5 inches thick. The subsoil is firm silty clay loam about 32 inches thick. The upper part is dark brown, and the lower part is reddish brown. The substratum to a depth of about 60 inches is reddish brown silty clay loam. In places the subsoil is less clayey. In areas where the upper part of the subsoil has been mixed with the surface soil by tillage, the surface layer is lighter in color.

Included with this soil in mapping are small areas of Clime and Tully soils. These soils are on side slopes above the Gymer soil. Clime soils are moderately deep over shale. Tully soils have a dark surface layer that is thicker than that of the Gymer soil. Also, they typically have a more clayey subsoil. Included soils make up about 10 percent of the map unit.

Permeability is moderately slow in the Gymer soil, and runoff is medium. Available water capacity is high. Organic matter content is moderate, and natural fertility is medium. The surface layer is medium acid. It is friable and can be easily tilled. The shrink-swell potential is moderate in the subsoil.

Nearly all of the acreage is used for cultivated crops. This soil has medium potential for grain sorghum, soybeans, wheat, and range. It has low potential for septic tank absorption fields and very high potential for sewage lagoons. The potential for dwellings is high.

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 loss. Some areas have slopes that are long enough and smooth enough for contour farming and terracing. 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 land capability classification is IIIe, and the range site is Loamy Upland.

Hn—Haynie very fine sandy loam, occasionally flooded. This deep, nearly level, moderately well drained soil is on flood plains along the major rivers. Individual areas are irregular in shape and range from 10 to 300 acres in size.

Typically, the surface layer is very dark grayish brown very fine sandy loam about 6 inches thick. The subsurface layer is very dark grayish brown, calcareous very fine sandy loam about 3 inches thick. The substratum to a depth of about 60 inches is calcareous silt loam. The upper part is brown, and the lower part is grayish brown and mottled. In some places the soil is darker below a depth of 10 inches. In other places the surface layer is calcareous. In some areas or the soil is more clayey.

Included with this soil in mapping are small areas of Eudora and Sarpy soils. The silty, noncalcareous Eudora soils are on stream terraces. The excessively drained Sarpy soils are more sandy than the Haynie soil. Also, they are closer to the river channels. Included soils make up about 15 percent of the map unit.

Permeability is moderate in the Haynie soil, and runoff is slow. Available water capacity is high. Organic matter content is moderate, and natural fertility is medium. The surface layer is mildly alkaline. It is friable and can be easily tilled. The shrink-swell potential is low.

Nearly all of the acreage is used for cultivated crops. A small acreage is wooded. This soil has very high potential for grain sorghum, soybeans, wheat, and range. It has very low potential for sewage lagoons. The potential for dwellings and septic tank absorption fields is low.

Flooding and soil blowing are hazards if cultivated crops are grown. In years of above average rainfall, the flooding delays planting and harvesting and causes some crop damage. It reduces yields in some years, but in other years the extra moisture may be beneficial. Overcoming the flooding hazard 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.

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

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

Hs—Haynie-Sarpy complex, occasionally flooded. These deep, nearly level soils are on flood plains along the major streams. The excessively drained Sarpy soil is on slight mounds above the moderately well drained Haynie soil. Individual areas are irregular in shape and range from 10 to several hundred acres in size. They are about 60 percent Haynie soil and 25 percent Sarpy soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the Haynie soil has a surface layer of very dark grayish brown very fine sandy loam about 6 inches thick. The subsurface layer is very dark grayish brown, calcareous very fine sandy loam about 3 inches thick. The substratum to a depth of about 60 inches is calcareous silt loam. The upper part is brown, and the lower part is grayish brown and mottled. In some places the soil is darker below a depth of 10 inches. In other places the surface layer is calcareous.

Typically, the Sarpy soil has a surface layer of dark grayish brown sand about 6 inches thick. The substratum to a depth of about 60 inches is brown and pale brown, loose sand. It is calcareous in the lower part. In some places the substratum is less sandy. In other places the surface layer is silty.

Included with these soils in mapping are small areas of the silty Eudora soils and the clayey Kimo soils. These included soils are on stream terraces. They make up about 15 percent of the map unit.

Permeability is moderate in the Haynie soil and rapid in the Sarpy soil. Runoff is slow on both soils. Available water capacity is high in the Haynie soil and low in the Sarpy soil. Organic matter content is moderate in the Haynie soil and low in the Sarpy soil. Natural fertility is medium in the Haynie soil and low in the Sarpy soil. The surface layer of the Haynie soil is mildly alkaline. It is friable and can be easily tilled. The surface layer of the Sarpy soil is neutral. It is loose and can be easily tilled. The shrink-swell potential is low in both soils.

Nearly all of the acreage is used for cultivated crops. Some small areas are wooded. These soils have medium potential for grain sorghum, soybeans, wheat, and range. They have low potential for septic tank absorption fields and dwellings and very low potential for sewage lagoons. The Haynie soil has low potential and the Sarpy soil very low potential for septic tank absorption fields.

If cultivated crops are grown, flooding and soil blowing are hazards on both soils. In areas of the Sarpy soil, droughtiness and the sandy surface layer are limitations. In years of above average rainfall, the flooding delays planting and harvesting and can cause some crop damage. It reduces yields in some years, but in other years the extra moisture may be beneficial. Overcoming the flooding hazard 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 Haynie soil is well suited to trees, and the Sarpy soil is moderately well suited. Plant competition is moderate on the Haynie soil. Seedlings and cuttings grow well only if competing plants are controlled. Seedling mortality is severe on the Sarpy soil because of droughtiness and the sandy surface layer. Thinning and selective cutting improve the stand.

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

Kc—Kennebec silt loam, channeled. This deep, nearly level, moderately well drained soil is on narrow flood plains that are deeply incised by stream channels. It is frequently flooded. Individual areas are long and irregularly shaped and range from 10 to 60 acres in size.

Typically, the surface layer is very dark brown silt loam about 6 inches thick. The subsurface layer is black silt loam about 36 inches thick. The subsoil is very dark grayish brown, friable silt loam about 12 inches thick. The substratum to a depth of about 60 inches is very dark grayish brown silt loam. In places the soil is calcareous throughout.

Included with this soil in mapping are small areas of Chase, Reading, and Tully soils. The clayey, somewhat poorly drained Chase soils and the well drained Reading soils are on stream terraces. Tully soils are more clayey than the Kennebec soil. They are on foot slopes. Included soils make up about 10 percent of the map unit.

Permeability is moderate in the Kennebec soil, and runoff is slow. Available water capacity, natural fertility, and organic matter content are high. The surface layer is neutral. The shrink-swell potential is moderate in the subsoil. A seasonal high water table is at a depth of 3 to 5 feet in winter and spring.

Nearly all of the acreage is used as range. Some small areas are wooded. Because of the flooding and the meandering stream channels, this soil has low potential for cultivated crops. It has medium potential for range. The potential for septic tank absorption fields, sewage lagoons, and dwellings is very low.

In areas used as range, flooding is a hazard and the invasion of woody plants is a limitation. The native vegetation is dominantly big bluestem, indiangrass, switchgrass, and eastern gamagrass. If the range is heavily used throughout the growing season, these grasses are replaced by less desirable plants, such as tall dropseed, Baldwin ironweed, and western ragweed. A proper stocking rate, a scheduled deferment of grazing during the growing season, a uniform distribution of grazing, and brush control help to keep the range productive.

Trees and shrubs grow along the banks of many of the streams. They can be used for wood products. They stabilize the banks, beautify the landscape, and add vegetative diversity. By providing food and cover, they also attract woodland wildlife species. This soil is well suited to trees. Plant competition is moderate. Seedlings and cuttings survive and grow well only if competing plants are controlled. Thinning and selective harvesting improve the stand.

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

Kf—Kennebec silt loam, occasionally flooded. This deep, nearly level, moderately well drained soil is on flood plains along creeks and rivers. Individual areas are long and wide and range from 10 to 160 acres in size.

Typically, the surface layer is very dark brown silt loam about 6 inches thick. The subsurface layer is black silt loam about 36 inches thick. The subsoil is very dark grayish brown, friable silt loam about 12 inches thick. The substratum to a depth of about 60 inches is very dark grayish brown silt loam. In places the lower part of the subsurface layer and the subsoil and substratum are silty clay loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Chase soils on terraces. These soils make up about 10 percent of the map unit.

Permeability is moderate in the Kennebec soil, and runoff is slow. Available water capacity, natural fertility, and organic matter content are high. The surface layer is neutral. It is friable and can be easily tilled. The shrink-swell potential is moderate in the subsoil. A seasonal high water table is at a depth of about 3 to 5 feet in winter and spring.

Nearly all of the acreage is used for cultivated crops. A small acreage is used as native woodland. This soil has high potential for grain sorghum, soybeans, wheat, and range. It has low potential for septic tank absorption fields and dwellings. The potential for sewage lagoons is very low.

If cultivated crops are grown, flooding is a hazard. In years of above average rainfall, it delays planting and harvesting and causes some crop damage. It reduces yields in some years, but in other years the extra moisture may be beneficial. Overcoming the flooding hazard is difficult without major flood-control measures. 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.

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

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

Km—Kimo silty clay. This deep, nearly level, somewhat poorly drained soil is on stream terraces along the major rivers. It is subject to rare flooding. Individual areas are irregular in shape and range from 10 to 30 acres in size.

Typically, the surface layer is black silty clay about 9 inches thick. The subsurface layer is about 13 inches thick. It is very dark grayish brown silty clay in the upper part and very dark grayish brown, mottled, calcareous silty clay loam in the lower part. The substratum to depth of about 60 inches is very dark grayish brown and dark grayish brown, mottled, calcareous silt loam. In some places the depth to silt loam is less than 20 inches. In other places the substratum is more clayey.

Included with this soil in mapping are small areas of Eudora, Haynie, and Sarpy soils. The well drained Eudora soils are higher on the landscape than the Kimo soil. The moderately well drained Haynie soils are nearer to the river channels than the Kimo soil. The excessively drained Sarpy soils are on small mounds. Included soils make up about 10 percent of the map unit.

Permeability is slow in the upper part of the Kimo soil and moderate in the substratum. Runoff is slow. Available water capacity is high. Natural fertility is medium, and organic matter content is moderate. The surface layer is slightly acid. It is firm, and tilth is poor.

The shrink-swell potential is high. A seasonal high water table is at a depth of about 2 to 6 feet during the spring.

Nearly all of the acreage is used for cultivated crops. Some small areas are wooded. This soil has high potential for grain sorghum, soybeans, wheat, and range. It has low potential for septic tank absorption fields, dwellings with basements, and sewage lagoons. The potential for dwellings without basements is medium.

If cultivated crops are grown, flooding is a hazard and wetness is a limitation. In some years of above average rainfall, the wetness delays planting and tillage. Open surface drains help to remove excess water, and timely tillage minimizes surface compaction. 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.

This soil is well suited to trees. The equipment limitation and seedling mortality are moderate. Thinning and selective harvesting improve the stand. Seedlings and cuttings survive and grow well if competing plants are controlled.

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

Mm—Monona silt loam, 5 to 10 percent slopes. This deep, strongly sloping, well drained soil is on concave foot slopes. Individual areas are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is very dark brown silt loam about 10 inches thick. The subsurface layer is dark grayish brown silt loam about 4 inches thick. The subsoil is dark brown, mottled, friable silt loam about 16 inches thick. The substratum to a depth of about 60 inches is brown, mottled silt loam. In areas where the upper part of the subsoil has been mixed with the surface soil by tillage, the surface layer is lighter colored. In places the subsoil is more clayey.

Included with this soil in mapping are small areas of Clime and Tully soils. The moderately deep Clime Soils are higher on the landscape than the Monona soil. Tully soils are in positions on the landscape similar to those of the Monona soil. They are more clayey than the Monona soil. Included soils make up about 10 percent of the map unit.

Permeability is moderate in the Monona soil, and runoff is rapid. Available water capacity is high. Organic matter content is moderate, and natural fertility is medium. The surface layer is neutral in the upper part and slightly acid in the lower part. It is friable and can be easily tilled. The shrink-swell potential is moderate in the subsoil.

Nearly all of the acreage is used for cultivated crops. This soil has medium potential for grain sorghum, soybeans, wheat, range, dwellings, and sewage lagoons. It has very high potential for septic tank absorption fields.

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 surface crusting, and increase the rate of water infiltration.

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

Mo—Morrill loam, 3 to 7 percent slopes. This deep, moderately sloping, well drained soil is on side slopes. Individual areas are irregular in shape and range from 5 to several hundred acres in size.

Typically, the surface layer is very dark brown loam about 10 inches thick. The subsoil is about 24 inches thick. The upper part is dark reddish brown, friable loam; the next part is reddish brown, firm clay loam; and the lower part is yellowish red, friable clay loam. The substratum to a depth of about 60 inches is yellowish red clay loam. In some places the subsoil is sandy loam, and other in places the lower part of the subsoil is clay. In some areas stones and boulders are on the surface. In other areas the soil is more than 20 inches deep to a clayey subsoil.

Included with this soil in mapping are small areas of Ortello and Pawnee soils. Ortello soils are on the lower side slopes. They are more sandy than the Morrill soil. Pawnee soils are on the higher side slopes. They are more clayey than the Morrill soil. Included soils make up about 10 percent of the map unit.

Permeability is moderate in the Morrill soil, and runoff is medium. Available water capacity is high. Organic matter content is moderate, and natural fertility is medium. The surface layer is medium acid. It is friable and can be easily tilled. The shrink-swell potential is moderate in the subsoil.

About half of the acreage is used for cultivated crops. The rest is used for range or native hay. This soil has medium potential for grain sorghum, soybeans, wheat, range, and sewage lagoons. It has high potential for dwellings. The potential for septic tank absorption fields is very high.

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 surface crusting, and increase the rate of water infiltration.

The invasion of woody plants is a limitation in the areas used as range. The native vegetation is dominantly big bluestem, indiangrass, little bluestem, and switchgrass. If the range is heavily used throughout the growing season, these grasses are replaced by less desirable plants, such as tall dropseed, Baldwin ironweed, and western ragweed. Water erosion is a hazard if the range is overgrazed. An adequate plant cover helps to prevent excessive soil loss. A proper stocking rate, a scheduled deferment of grazing during the growing season, a uniform distribution of grazing, and brush control help to keep the range productive.

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

Mr—Morrill clay loam, 3 to 7 percent slopes, eroded. This deep, moderately sloping, well drained soil is on convex side slopes. Sheet erosion has removed more than half of the surface layer in most places. In a few areas the subsoil is exposed. The soil has some rills and shallow gullies, which can be crossed by farm equipment. Individual areas are irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is very dark grayish brown clay loam about 6 inches thick. The subsoil is clay loam about 24 inches thick. The upper part is dark reddish brown and friable, the next part is reddish brown and firm, and the lower part is yellowish red and friable. The substratum to a depth of about 60 inches is yellowish red clay loam. In some places the surface layer is less clayey. In other places the subsoil is more clayey. In some areas stones and boulders are on the surface.

Included with this soil in mapping are small areas of Ortello soils on the lower side slopes. These soils are more sandy than the Morrill soil. They make up about 5 percent of the map unit.

Permeability is moderate in the Morrill soil, and runoff is medium. Available water capacity is high. Organic matter content and natural fertility are low. The surface layer is medium acid. It is friable when moist and generally cloddy when dry. The shrink-swell potential is moderate in the subsoil.

About half of the acreage is used for cultivated crops. The rest is pastured or has been reseeded to native grass. Nearly all of the acreage has been cultivated at some time in the past. This soil has medium potential for grain sorghum, wheat, range, and sewage lagoons. It has high potential for dwellings and septic tank absorption fields.

Further water erosion is a hazard if cultivated crops are grown. Reducing the number of tillage operations, planting winter cover crops, 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 surface crusting, and increase the rate of water infiltration.

The invasion of woody plants is a limitation in the areas used as range. This soil generally has no native vegetation unless it has been reseeded. Grazing when the soil is too wet causes surface compaction, reduces the rate of water infiltration, and increases the runoff rate and the hazard of water erosion. A proper stocking rate, a scheduled deferment of grazing during the growing season, a uniform distribution of grazing, restricted use during wet periods, brush control, and reseeding are needed.

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

Mt—Morrill loam, 5 to 20 percent slopes, stony. This deep, strongly sloping and moderately steep, well drained soil is on narrow ridgetops and the upper side slopes. Numerous stones and boulders are on the surface. They are rounded and range from 1 inch to 3 feet in diameter. They cover less than 1 percent of the surface and are 2 to 20 feet apart. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is very dark brown loam about 10 inches thick. The subsoil is about 24 inches thick. The upper part is dark reddish brown, friable loam; the next part is reddish brown, firm clay loam; and the lower part is yellowish red, friable clay loam. The substratum to a depth of about 60 inches is yellowish red clay loam. In some places the lower part of the subsoil is clay. In other places the soil is more than 20 inches deep to a clayey subsoil.

Included with this soil in mapping are small areas of Pawnee and Wymore Variant soils. Pawnee soils have a subsoil that is mottled and is more clayey than that of the Morrill soil. They are on the upper side slopes. Wymore Variant soils have a surface layer of fine sandy loam. They are on narrow ridgetops. Included soils make up about 15 percent of the map unit.

Permeability is moderate in the Morrill soil, and runoff is rapid. Available water capacity is high. Organic matter content is moderate, and natural fertility is medium. The surface layer is medium acid. The shrink-swell potential is moderate in the subsoil.

Nearly all of the acreage is used as range. Some small areas are wooded. Because of the slope, the surface stones, and the hazard of water erosion, this soil has very low potential for cultivated crops. It has medium potential for range and for dwellings. The potential for septic tank absorption fields is very high, and the potential for sewage lagoons is low.

The invasion of woody plants, the slope, and the surface stones are limitations in the areas used as range. The native vegetation is dominantly big bluestem, little bluestem, and indiangrass. If the range is heavily used throughout the growing season, these grasses are replaced by less desirable plants, such as tall dropseed, Baldwin ironweed, and western ragweed.

Water erosion is a hazard if the range is overgrazed. An adequate plant cover helps to prevent excessive soil loss. A proper stocking rate, a scheduled deferment of grazing during the growing season, a uniform distribution of grazing, and brush control help to keep the range productive.

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

Mu—Muir silt loam. This deep, nearly level, well drained soil is on stream terraces along the major rivers. It is subject to rare flooding. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is very dark brown silt loam about 5 inches thick. The subsurface layer also is very dark brown silt loam. It is about 17 inches thick. The subsoil is dark grayish brown, friable silt loam about 22 inches thick. The substratum to a depth of about 60 inches is dark brown silt loam. In some places the subsoil is lighter in color, and in other places it is more clayey.

Included with this soil in mapping are small areas of the somewhat poorly drained Chase and poorly drained Zook soils. These soils are more clayey throughout than the Muir soil. They are in positions on the landscape similar to those of the Muir soil. They make up about 10 percent of the map unit.

Permeability is moderate in the Muir soil, and runoff is slow. Organic matter content is moderate. Available water capacity and natural fertility are high. The surface layer is neutral. It is friable and can be easily tilled. The shrink-swell potential is low in the subsoil.

Nearly all of the acreage is used for cultivated crops. This soil has very high potential for grain sorghum, soybeans, wheat, and range. It has low potential for septic tank absorption fields and medium potential for sewage lagoons and dwellings.

No major hazards or limitations affect the use of this soil for cultivated crops. 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 land capability classification is I, and the range site is Loamy Lowland.

Op—Ortello fine sandy 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 5 to 200 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 5 inches thick. The subsurface layer is very dark brown fine sandy loam about 5 inches thick. The next layer is very dark grayish brown fine sandy loam about 9 inches thick. The subsoil is dark yellowish brown, friable fine sandy loam about 8 inches thick. The substratum to a depth of about 60 inches is dark yellowish brown loamy fine sand. In some places the subsoil and substratum are more clayey. In other places the subsoil is more sandy.

Included with this soil in mapping are small areas of Morrill and Pawnee soils. Morrill soils have a subsoil that is dominantly clay loam. They are higher on the landscape than the Ortello soil. Pawnee soils have a clayey subsoil. They are on the upper side slopes. Included soils make up about 20 percent of the map unit.

Permeability is moderately rapid in the Ortello soil, and runoff is medium. Available water capacity and organic matter content are moderate. Natural fertility is low. The surface layer is slightly acid. It is very friable and can be easily tilled. The shrink-swell potential is low in the subsoil.

About half of the acreage is used for cultivated crops, and the rest is used as range or pasture. This soil has low potential for grain sorghum, soybeans, and wheat and medium potential for range and for sewage lagoons. It has very high potential for septic tank absorption fields and dwellings.

If cultivated crops are grown, soil blowing and water erosion are hazards and droughtiness is a limitation. Reducing the number of tillage operations, planting winter cover crops, 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 surface crusting, and increase the rate of water infiltration.

The invasion of woody plants and the droughtiness are limitations in the areas used as range. The native vegetation is dominantly sand bluestem, little bluestem, indiangrass, and switchgrass. If the range is heavily used throughout the growing season, these grasses are replaced by less productive plants, such as sand dropseed, sand paspalum, blue grama, and western ragweed. A proper stocking rate, a scheduled deferment of grazing during the growing season, a uniform distribution of grazing, and brush control help to keep the range productive.

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

Ot—Ortello fine sandy loam, 7 to 12 percent slopes. This deep, strongly sloping, well drained soil is on side slopes. Individual areas are irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 5 inches thick. The subsurface layer is very dark brown fine sandy loam about 5 inches thick. The next layer is very dark grayish brown fine sandy loam about 9 inches thick. The subsoil is dark yellowish brown, friable fine sandy loam about 8 inches thick. The substratum to a depth of about 60 inches is dark yellowish brown loamy fine sand. In some places the subsoil is clay loam. In other places the surface layer is loamy fine sand.

Included with this soil in mapping are small areas of Morrill and Pawnee soils. Morrill soils have a subsoil that is dominantly clay loam. They are higher on the landscape than the Ortello soil. Pawnee soils have a clayey subsoil. They are on the upper side slopes. Included soils make up about 10 percent of the map unit.

Permeability is moderately rapid in the Ortello soil, and runoff is medium. Available water capacity is moderate. Organic matter content also is moderate, and natural fertility is low. The surface layer is slightly acid. It is very friable and can be easily tilled. The shrink-swell potential is low in the subsoil.

About 75 percent of the acreage is used as range, and the rest is used for cultivated crops. This soil has low potential for grain sorghum and wheat and medium potential for range. It has high potential for dwellings, very high potential for septic tank absorption fields, and low potential for sewage lagoons.

If cultivated crops are grown, soil blowing and water erosion are hazards and droughtiness is a limitation. Reducing the number of tillage operations, planting winter cover crops, 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 surface crusting, and increase the rate of water infiltration.

The invasion of woody plants and the droughtiness are limitations in the areas used as range. The native vegetation is dominantly sand bluestem, little bluestem, needleandthread, and western wheatgrass. If the range is heavily used throughout the growing season, these grasses are replaced by less productive plants, such as sand dropseed, sand paspalum, blue grama, and western ragweed. A proper stocking rate, a scheduled deferment of grazing during the growing season, a uniform distribution of grazing, and brush control help to keep the range productive.

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

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

Typically, the surface layer is very dark brown clay loam about 10 inches thick. The subsoil is about 32 inches thick. The upper part is dark brown, mottled, firm clay loam, and the lower part is dark yellowish brown and yellowish brown, mottled, firm clay. The substratum to a depth of about 60 inches is mixed light olive brown and grayish brown, mottled clay loam. In some areas the subsoil is redder. In other areas it is less clayey. In places 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. These soils make up about 10 percent of the map unit.

Permeability is slow in the Pawnee soil, and runoff is medium. Natural fertility is high. Organic matter content and available water capacity are moderate. The surface layer is slightly acid. It is friable and can be easily tilled. 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 during the spring.

Nearly all of the acreage is used for cultivated crops. This soil has medium potential for grain sorghum, soybeans, wheat, and range. It has low potential for septic tank absorption fields and dwellings. The potential for sewage lagoons is very high.

If cultivated crops are grown, water erosion is a hazard and droughtiness and restricted root growth are problems. The clayey subsoil restricts the movement of air and water and the growth of roots and releases water slowly to plants. 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 surface crusting, and increase the rate of water infiltration.

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

Pn—Pawnee clay loam, 3 to 6 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 several hundred acres in size.

Typically, the surface layer is very dark brown clay loam about 10 inches thick. The subsoil is about 32 inches thick. The upper part is dark brown, mottled, firm clay loam, and the lower part is dark yellowish brown and yellowish brown, mottled, firm clay. The substratum to a depth of about 60 inches is mixed light olive brown and grayish brown 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. These soils make up about 10 percent of the map unit.

Permeability is slow in the Pawnee soil, and runoff is medium. Natural fertility is high. Available water capacity and organic matter content are moderate. The surface layer is slightly acid. It is friable and can be easily tilled. The shrink-swell potential is high in the subsoil. A

Figure 9.—Profile of Pawnee clay loam, 1 to 3 percent slopes. Cracks form during dry periods, when the soil shrinks. Depth is marked in feet.

perched seasonal high water table is at a depth of about 1 to 3 feet during the spring.

Nearly all of the acreage is used for cultivated crops. This soil has medium potential for grain sorghum, soybeans, wheat, and range. It has low potential for septic tank absorption fields and dwellings. The potential for sewage lagoons is high.

If cultivated crops are grown, water erosion is a hazard and droughtiness and restricted root growth are problems. The clayey subsoil restricts the movement of air and water and the growth of roots and releases water slowly to plants. Reducing the number of tillage operations, planting winter cover crops, farming on the contour, establishing grassed waterways, terracing, and applying a system of 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 land capability classification is IIIe, and the range site is Clay Upland.

Po—Pawnee clay, 3 to 6 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 areas the subsoil is exposed. The soil has some rills and shallow gullies, which can be crossed by farm equipment. Individual areas are irregular in shape and range from 5 to about 25 acres in size.

Typically, the surface layer is very dark brown clay about 6 inches thick. The subsoil is mottled, firm clay about 32 inches thick. The upper part is dark brown, the next part is dark yellowish brown, and the lower part is yellowish brown. The substratum to a depth of about 60 inches is mixed light olive brown and grayish brown clay loam. In some places the surface layer and subsoil are redder. In other places the subsoil is less clayey. In some areas stones and boulders are on the surface.

Permeability is slow in the Pawnee soil, and runoff is rapid. Natural fertility and organic matter content are low. Available water capacity is moderate. The surface layer is slightly acid. It is firm and generally cloddy when dry, and tilth is poor. Cracking of the surface layer and subsoil may occur during dry periods. 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 during the spring.

Nearly all of the acreage is used for cultivated crops. The rest has been reseeded to grass or is abandoned cropland. This soil has low potential for grain sorghum, soybeans, wheat, range, septic tank absorption fields, and dwellings. The potential for sewage lagoons is high.

If cultivated crops are grown, further water erosion is a hazard and droughtiness, the clayey surface layer, and restricted root growth are limitations. The clayey surface layer and subsoil restrict the movement of air and water and the growth of roots and release water slowly to plants. 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 surface crusting, and increase the rate of water infiltration.

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

Ps—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 50 acres in size.

Typically, the surface layer is very dark grayish brown, calcareous silt loam about 9 inches thick. The substratum to a depth of more than 60 inches is calcareous. The upper part is dark grayish brown and very dark grayish brown, mottled silt loam, and the lower part is dark grayish brown loamy fine sand. In places the depth to loamy fine sand is less than 20 or more than 60 inches.

Included with this soil in mapping are small areas of Haynie and Sarpy soils. The moderately well drained Haynie soils are higher on the landscape than the Paxico soil. The excessively drained Sarpy soils are more sandy throughout 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, and runoff is slow. Available water capacity is high. Organic matter content is moderate, and natural fertility is medium. The surface layer is moderately alkaline. It is friable and can be easily tilled. The shrink-swell potential is low. A seasonal high water table is at a depth of about 1 to 3 feet in winter and spring. It is controlled by the water level in the adjacent rivers and streams.

Nearly all of the acreage is idle land. A few small areas are used for cultivated crops or wildlife habitat. The vegetation includes cottonwood and willow trees and a few grasses. Because of the flooding, the wetness, and hazard of soil blowing, this soil has very low potential for cultivated crops. It has medium potential for range and very low potential for septic tank absorption fields, dwellings, and sewage lagoons.

Trees and shrubs grow along the banks of many of the streams. They can be used for wood products. They stabilize the streambanks, beautify the landscape, and add vegetative diversity. By providing food and cover, they also attract woodland wildlife species. This soil is moderately well suited to trees. Seedling mortality and plant competition are moderate, and the equipment limitation is severe. Harvesting equipment can only be used only during dry periods. Seedlings and cuttings survive and grow well only if competing plants are controlled. Thinning and selective harvesting improve the stand.

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

Pt—Pits, quarries. This map unit consists mainly of open excavations from which soil and much of the underlying gravel, sand, limestone, and shale have been removed. Most of the larger excavations are on uplands, mainly in areas of Clime and Sogn soils. The exposed areas of limestone or shale range from 3 to 30 acres in size and have vertical walls 10 to 30 feet high. They support few or no plants. The larger pits are filled with water. Some of the pits are in areas of glacial till where sand and gravel have been removed. Soil material in long, narrow pits along highways has been removed for use in highway construction. These pits support some grasses.

No land capability classification or range site is assigned.

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 10 to 500 acres in size.

Typically, the surface layer is black silty clay loam about 6 inches thick. The subsurface layer also is black silty clay loam. It is about 14 inches thick. The subsoil is friable silty clay loam about 33 inches thick. The upper part is very dark brown, the next part is very dark grayish brown, and the lower part is dark brown. The substratum to a depth of about 60 inches is dark brown silty clay loam. In places the soil is less clayey throughout.

Included with this soil in mapping are small areas of Chase and Tully soils. The somewhat poorly drained Chase soils are on the lower terraces. They are more clayey than the Reading soil. The slowly permeable Tully soils are more clayey in the subsoil than the Reading soil. They are on foot slopes. Included soils make up about 10 percent of the map unit.

Permeability is moderately slow in the Reading soil, and runoff is slow. Organic matter content is moderate. Available water capacity and natural fertility are high. The surface layer is slightly acid. It is friable and can be easily tilled. The shrink-swell potential is moderate in the subsoil.

Nearly all of the acreage is used for cultivated crops. A small acreage is native woodland. This soil has very high potential for grain sorghum, soybeans, wheat, and range. It has medium potential for dwellings and sewage lagoons. The potential for septic tank absorption fields is low.

No major hazards or limitations affect the use of this soil for cultivated crops. 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.

This soil is well suited to trees. Plant competition is moderate. Seedlings and cuttings survive and grow well only if competing plants are controlled. Thinning and selective harvesting improve the stand.

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

Sf—Sarpy sand, frequently flooded. This deep, nearly level, excessively drained soil is on flood plains along the major rivers. Individual areas are irregular in shape and range from 10 to 50 acres in size.

Typically, the surface layer is dark grayish brown sand about 6 inches thick. The substratum to a depth of about 60 inches is brown and pale brown, loose sand. It is calcareous in the lower part. In places the surface layer is silty.

Included with this soil in mapping are small areas of Eudora, Haynie, and Kimo soils. The silty Eudora and Haynie soils are in positions on the landscape similar to those of the Sarpy soil. The clayey Kimo soils are in slight depressions. Included soils make up about 10 percent of the map unit.

Permeability is rapid in the Sarpy soil, and runoff is slow. Available water capacity, organic matter content, and natural fertility are low. The surface layer is neutral. It is loose and can be easily tilled. The shrink-swell potential is low.

Most of the acreage is used as range. A small acreage is native woodland. Because of the hazards of flooding and soil blowing and the sandy surface layer, this soil has very low potential for cultivated crops. It also has very low potential for range and for septic tank absorption fields, dwellings, and sewage lagoons.

In the areas used as range, the flooding is a hazard and droughtiness and the invasion of woody plants are limitations. The native vegetation is dominantly little bluestem, sand bluestem, and switchgrass. If the range is heavily used throughout the growing season, these grasses are replaced by less desirable plants, such as sand dropseed, sand paspalum, purpletop, and western ragweed.

Soil blowing is a hazard if the range is overgrazed. An adequate plant cover helps to prevent excessive soil loss. A proper stocking rate, a scheduled deferment of grazing during the growing season, a uniform distribution of grazing, and brush control help to keep the range productive.

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

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

Sg—Sharpsburg silt loam, 1 to 4 percent slopes. This deep, gently sloping, moderately well drained soil is on ridgetops and the upper side slopes. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 5 inches thick. The subsoil is firm silty clay loam about 32 inches thick. The upper part is dark brown, and the lower part is brown and mottled. The substratum to a depth of about 60 inches is brown, mottled silty clay loam. In places the subsoil is redder.

Included with this soil in mapping are small areas of Morrill, Ortello, and Wymore Variant soils. The well drained Morrill and Ortello soils are on the lower side slopes. They are more sandy than the Sharpsburg soil. The slowly permeable Wymore Variant soils are on ridgetops above the Sharpsburg soil. Included soils make up about 10 percent of the map unit.

Permeability is moderately slow in the Sharpsburg soil, and runoff is medium. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is slightly acid. It is friable and can be easily tilled. The shrink-swell potential is moderate in the subsoil.

Nearly all of the acreage is used for cultivated crops. This soil has medium potential for grain sorghum, soybeans, wheat, range, and sewage lagoons. It has high potential for dwellings. The potential for septic tank absorption fields is very high.

Water erosion is a hazard if cultivated crops are grown. Reducing the number of tillage operations, planting winter cover crops, 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 surface crusting, and increase the rate of water infiltration.

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

Th—Thurman loamy fine sand, 3 to 8 percent slopes. This deep, moderately sloping, somewhat excessively drained soil is on side slopes. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is very dark grayish brown loamy fine sand about 10 inches thick. The subsurface layer is dark brown loamy fine sand about 7 inches thick. The substratum to a depth of about 60 inches is loose loamy fine sand. It is brown in the upper part and yellowish brown in the lower part. In places the subsurface layer is fine sandy loam.

Included with this soil in mapping are small areas of Morrill and Pawnee soils. These soils are less sandy than the Thurman soil. They are on side slopes above the Thurman soil. They make up about 15 percent of the map unit.

Permeability is rapid in the Thurman soil, and runoff is slow. Available water capacity and natural fertility are low. Organic matter content is moderate. The surface layer is neutral. It is friable and can be easily tilled. The shrink-swell potential is low.

Nearly all of the acreage is used as range. Because of the hazard of soil blowing, droughtiness, and the sandy surface layer, this soil has low potential for grain sorghum, soybeans, and wheat. It has medium potential for range and for septic tank absorption fields. The potential for dwellings is very high, and the potential for sewage lagoons is very low.

The invasion of woody plants and the droughtiness are limitations in the areas used as range. The native vegetation is dominantly sand bluestem, little bluestem, prairie dropseed, blue grama, and needleandthread. If the range is used throughout the growing season, these grasses are replaced by less desirable plants, such as sand dropseed, sand paspalum, blue grama, and western ragweed.

Soil blowing is a hazard if the range is overgrazed. An adequate plant cover helps to prevent excessive soil loss. A proper stocking rate, a scheduled deferment of grazing during the growing season, a uniform distribution of grazing, and brush control help to keep the range productive.

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

Tu—Tully silty clay loam, 3 to 7 percent slopes. This deep, moderately sloping, well drained soil is on concave foot slopes. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is black silty clay loam about 13 inches thick. The subsoil is about 47 inches thick. The upper part is very dark grayish brown, firm silty clay loam, and the lower part is very dark grayish brown and dark brown, mottled, firm silty clay. In places the subsoil is redder. In areas where the upper part of the subsoil and the surface layer have been mixed by tillage, the surface layer is lighter in color.

Included with this soil in mapping are small areas of Clime, Kennebec, and Reading soils. The moderately deep Clime soils are on the upper side slopes. The silty Kennebec soils are on flood plains. Reading soils are on stream terraces. They are less clayey than the Tully soil. Included soils make up about 10 percent of the map unit.

Permeability is slow in the Tully soil, and runoff is medium. Available water capacity and organic matter content are moderate. Natural fertility is medium. The surface layer is medium acid. It is friable and can be easily tilled. The shrink-swell potential is high in the subsoil.

About 60 percent of the acreage is used as range. The rest is used for cultivated crops, pasture, or hay. This soil has medium potential for grain sorghum, soybeans, wheat, range, and dwellings without basements. It has low potential for septic tank absorption fields and for dwellings with basements. The potential for sewage lagoons is very high.

If cultivated crops are grown, water erosion is a hazard and droughtiness is a limitation. Cracks form during droughty periods (fig. 10). Reducing the number of tillage operations, planting winter cover crops, 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 surface crusting, and increase the rate of water infiltration.

Figure 10.—A cultivated area of Tully silty clay loam, 3 to 7 percent slopes, where cracks have formed.

The invasion of woody plants is a limitation in the areas used as range. The native vegetation is dominantly big bluestem, little bluestem, indiangrass, and switchgrass. If the range is heavily used throughout the growing season, these grasses are replaced by less desirable plants, such as tall dropseed, Baldwin ironweed, and western ragweed.

Water erosion is a hazard if the range is overgrazed. An adequate plant cover helps to prevent excessive soil loss. Grazing when the soil is too wet causes surface compaction, reduces the rate of water infiltration, and increases the runoff rate. A proper stocking rate, a scheduled deferment of grazing during the growing season, a uniform distribution of grazing, restricted use during wet periods, and brush control help to keep the range productive.

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

Tx—Tully silty clay, 3 to 7 percent slopes, eroded. This deep, moderately sloping, well drained soil is on concave foot slopes. Sheet erosion has removed more than half of the surface layer in most places. In a few areas the subsoil is exposed. The soil has some rills and shallow gullies, which can be crossed by farm equipment. Individual areas are irregular in shape and range from 5 to 30 acres in size.

Typically, the surface layer is black silty clay about 4 inches thick. The subsoil is firm silty clay about 56 inches thick. The upper part is very dark grayish brown, the next part is very dark grayish brown and mottled, and the lower part is dark brown and mottled. In places the subsoil is redder. In areas where the upper part of the subsoil and the surface layer have been mixed by tillage, the surface layer is lighter in color. In some areas shale is within a depth of 60 inches.

Included with this soil in mapping are small areas of Clime, Kennebec, and Reading soils. The moderately deep Clime soils are on the upper side slopes. The silty Kennebec soils are on flood plains. Reading soils are on stream terraces. They are less clayey than the Tully soil. Included soils make up about 15 percent of the map unit.

Permeability is slow in the Tully soil, and runoff is rapid. Available water capacity and organic matter content are moderate. Natural fertility is medium. The surface layer is medium acid. It is firm when moist and generally is cloddy when dry, and tilth is poor. The shrink-swell potential is high in the subsoil.

About 80 percent of the acreage is used for cultivated crops. The rest is used as pasture or has been reseeded to native grasses. Nearly all of the acreage has been cultivated in the past. This soil has medium potential for grain sorghum, wheat, range, and dwellings without basements. It has low potential for septic tank absorption fields and for dwellings with basements. The potential for sewage lagoons is very high.

If cultivated crops are grown, further water erosion is a hazard and droughtiness, the clayey surface layer, and restricted root growth are limitations. The clayey surface and subsoil restrict the movement of air and water and the growth of roots and release water slowly to plants. Reducing the number of tillage operations, planting winter cover crops, 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 surface crusting, and increase the rate of water infiltration.

The invasion of woody plants is a limitation in the areas used as range. The native vegetation is dominantly big bluestem, little bluestem, indiangrass, and switchgrass. If the range is heavily used throughout the growing season, these grasses are replaced by less desirable plants, such as tall dropseed, Baldwin ironweed, and western ragweed.

Water erosion is a hazard if the range is overgrazed. An adequate plant cover helps to prevent excessive soil loss. Grazing when the soil is too wet causes surface compaction, reduces the rate of water infiltration, and increases the runoff rate. A proper stocking rate, a scheduled deferment of grazing during the growing season, a uniform distribution of grazing, restricted use during wet periods, and brush control help to keep the range productive.

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

Tz—Tuttle channery silty clay loam, 20 to 40 percent slopes, stony. This deep, steep, somewhat excessively drained soil is on upland breaks and side slopes. Numerous limestone rocks are on the surface. They are irregular in shape and range from 1 to 2 feet in diameter. They cover less than 1 percent of the surface and are 2 to 6 feet apart. Individual areas are irregular in shape and range from 20 to several hundred acres in size.

Typically, the surface layer is very dark brown, calcareous channery silty clay loam about 15 inches thick. The subsoil is about 31 inches thick. It is friable. The upper part is very dark grayish brown and dark reddish gray, calcareous channery silty clay loam, and the lower part is brown, calcareous silty clay loam. Calcareous silty shale is at a depth of about 46 inches. In some places the soil has chert fragments. In other places it is noncalcareous.

Included with this soil in mapping are small areas of Clime, Sogn, and Tully soils. 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. The well drained Tully soils are on foot slopes. Included soils make up about 15 percent of the map unit.

Permeability is slow in the Tuttle soil, and runoff is very rapid. Available water capacity and organic matter content are moderate. Natural fertility is medium. The surface layer is moderately alkaline. The shrink-swell potential is moderate in the subsoil. Root development is restricted below a depth of about 46 inches.

All of the acreage supports native trees or is used as range. The wooded areas provide food and cover for deer. Because of the hazard of water erosion, droughtiness, the slope, and the small stones, this soil has very low potential for cultivated crops. It also has very low potential for range, but it is best suited to this use. The potential for dwellings and sewage lagoons is low, and the potential for septic tank absorption fields is very low.

The invasion of woody plants, the droughtiness, the slope, and the surface stones are limitations in the areas used as range. Limited accessibility is an additional limitation. The native vegetation is dominantly chinkapin oak and hickory trees. Properly distributed salting and watering facilities and fences help to achieve a more uniform distribution of grazing. Grazing when the soil is too wet causes surface compaction, reduces the rate of water infiltration, and increases the runoff rate. A proper stocking rate, a scheduled deferment of grazing during the growing season, a uniform distribution of grazing, restricted use during wet periods, and brush control help to keep the range productive.

This soil is moderately well suited to trees. The erosion hazard, the equipment limitation, seedling mortality, and plant competition are moderate. Because of the slope, the use of logging equipment is restricted and erosion is a hazard along logging roads and skid trails. Thinning and selective harvesting improve the stand.

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 several hundred acres in size.

Typically, the surface layer is very dark gray silty clay about 5 inches thick. The subsurface layer also is very dark gray silty clay. It is about 13 inches thick. The subsoil to a depth of more than 60 inches is very firm, mottled silty clay. The upper part is very dark gray, the next part is dark gray, and the lower part is dark grayish brown. In places the surface layer and subsurface layer are less clayey.

Included with this soil in mapping are small areas of Kennebec and Reading soils. The moderately well drained, silty Kennebec soils are nearer to the stream channels than the Wabash soil. The well drained Reading soils are on stream terraces. Included soils make up about 10 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 neutral. It is firm, and tilth is poor. The shrink-swell potential is very high in the subsoil. A seasonal high water table is within a depth of 1 foot in winter and spring.

Nearly all of the acreage is used for cultivated crops. A small acreage is native woodland. This soil has medium potential for grain sorghum, soybeans, and wheat and high potential for range. It has very low potential for septic tank absorption fields, dwellings, and sewage lagoons.

If cultivated crops are grown, flooding is a hazard and wetness is a limitation. Crop yields are reduced in some years because of the flooding, but in others years the extra moisture may be beneficial. In years of above average rainfall, the wetness and the flooding delay planting and harvesting and cause some crop damage. Overcoming the flooding hazard is difficult without major flood-control measures. Bedding helps to remove excess surface water. If the soil is tilled when it is too wet, surface compaction is a problem. It can be minimized by timely tillage. The clayey surface soil and subsoil restrict the movement of air and water and the growth of roots and release water slowly to plants. 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.

This soil is well suited to trees. Because of the wetness, the equipment limitation is severe. Plant competition and seedling mortality also are severe. The trees should be harvested in fall and winter, when the amount of precipitation is lower. Seedlings and cuttings survive and grow well only if competing plants are controlled. Proper site preparation and controlled burning, spraying, or cutting are needed.

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

Wd—Wamego silt 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 several hundred acres in size.

Typically, the surface layer is very dark gray silt loam about 6 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 4 inches thick. The subsoil is friable silty clay loam about 17 inches thick. The upper part is dark brown and has some fine sandstone fragments. The lower part is yellowish brown and has many fine sandstone and shale fragments. Pale brown and yellowish brown shale is at a depth of about 27 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 Elmont, Pawnee, and Wymore soils and rock outcrops. The deep Elmont soils are on foot slopes. The deep Pawnee and Wymore soils are on ridgetops and the upper side slopes. They are more clayey than the Wamego soil. The rock outcrops are near the ridgetops.

Included areas make up about 15 percent of the map unit.

Permeability is slow in the Wamego soil, and runoff is medium. Available water capacity is low. Organic matter content is moderate, and natural fertility is medium. The surface layer is slightly acid. It is friable and can be easily tilled. The shrink-swell potential is moderate in the subsoil. Root development is restricted below a depth of about 27 inches.

Nearly all of the acreage is used as range. This soil has low potential for cultivated crops. It has medium potential for range, for dwellings with basements, and for sewage lagoons. The potential for septic tank absorption fields is low, and the potential for dwellings without basements is high.

Droughtiness and the restricted rooting depth are limitations in the areas used as range. The native vegetation is dominantly big bluestem, little bluestem, indiangrass, and switchgrass. If the range is heavily used throughout the growing season, these grasses are replaced by less desirable plants, such as tall dropseed, Baldwin ironweed, and western ragweed.

Water erosion is a hazard if the range is overgrazed. An adequate plant cover helps to prevent excessive soil loss. Grazing when the soil is too wet causes surface compaction, reduces the rate of water infiltration, and increases the runoff rate. A proper stocking rate, a scheduled deferment of grazing during the growing season, a uniform distribution of grazing, and restricted use during wet periods help to keep the range productive.

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

We—Wamego silt loam, 7 to 20 percent slopes. This moderately deep, strongly sloping and moderately steep, well drained soil is on side slopes. Individual areas are irregular in shape and range from 50 to several hundred acres in size.

Typically, the surface layer is very dark gray silt loam about 6 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 4 inches thick. The subsoil is friable silty clay loam about 17 inches thick. The upper part is dark brown and has some fine sandstone fragments. The lower part is yellowish brown and has many fine sandstone and shale fragments. Pale brown and yellowish brown shale is at a depth of about 27 inches. In some places the depth to bedrock is less than 20 inches, and in other places it is more than 50 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 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. The shallow Sogn soils are on breaks above the Wamego soil. The rock outcrops are near the breaks and ridgetops. Included areas make up about 15 percent of the map unit.

Permeability is slow in the Wamego soil, and runoff is rapid. Available water capacity is low. Organic matter content is moderate, and natural fertility is medium. The surface layer is slightly acid. The shrink-swell potential is moderate in the subsoil. Root development is restricted below a depth of about 27 inches.

Nearly all of the acreage is used as range. Because of the hazard of water erosion, the slope, and droughtiness, this soil has very low potential for cultivated crops. It has medium potential for range and for dwellings. The potential for septic tank absorption fields is very low, and the potential for sewage lagoons is low.

The invasion of woody plants, the droughtiness, and the restricted rooting depth are limitations in the areas used as range. The native vegetation is dominantly big bluestem, little bluestem, indiangrass, and switchgrass. If the range is heavily used throughout the growing season, these grasses are replaced by less desirable plants, such as tall dropseed, Baldwin ironweed, and western ragweed.

Water erosion is a hazard if the range is overgrazed. An adequate plant cover helps to prevent excessive soil loss. Grazing when the soil is too wet causes surface compaction, reduces the rate of water infiltration, and increases the runoff rate. A proper stocking rate, a scheduled deferment of grazing during the growing season, a uniform distribution of grazing, restricted use during wet periods, and brush control help to keep the range productive.

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

Wg—Wann fine sandy loam, channeled. This deep, nearly level, somewhat poorly drained soil is on flood plains along upland drainageways. It is frequently flooded. Individual areas are long and narrow and range from 5 to 50 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 11 inches thick. The subsoil is dark brown, mottled, friable fine sandy loam about 9 inches thick. The substratum to a depth of about 60 inches is stratified. The upper part is dark grayish brown and brown, mottled sandy loam, and the lower part is brown and dark grayish brown, mottled fine sandy loam. In some places the substratum is silty. In other places the surface layer is silty.

Included with this soil in mapping are small areas of the moderately well drained Kennebec and somewhat poorly drained Paxico soils. These soils are less sandy than the Wann soil. They are in positions on the landscape similar to those of the Wann soil. They make up about 15 percent of the map unit.

Permeability is moderately rapid in the Wann soil, and runoff is slow. Available water capacity is moderate. Natural fertility is medium, and organic matter content is low. The surface layer is neutral. It is friable and can be easily tilled. The shrink-swell potential is low in the subsoil. A seasonal high water table is at a depth of about 1.5 to 3.5 feet during the spring.

Almost all of the acreage is used as range or hayland. Because of flooding and wetness, this soil has low potential for cultivated crops. It has high potential for range. The potential for septic tank absorption fields, dwellings, and sewage lagoons is very low.

In the areas used as range, the flooding is a hazard and the invasion of woody plants is a limitation. The native vegetation is dominantly big bluestem, indiangrass, and prairie cordgrass. If the range is heavily used throughout the growing season, these grasses are replaced by less desirable plants, such as western wheatgrass, tall dropseed, and sedges.

Soil blowing is a hazard if the range is overgrazed. An adequate plant cover helps to prevent excessive soil loss. A proper stocking rate, a scheduled deferment of grazing during the growing season, a uniform distribution of grazing, and brush control help to keep the range productive.

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

Wk—Wymore silty clay loam, 0 to 1 percent slopes. This deep, nearly level, moderately well drained soil is on high terraces and on ridgetops. Individual areas are irregular in shape and range from 20 to several hundred acres in size.

Typically, the surface layer is very dark brown silty clay loam about 6 inches thick. The subsoil extends to a depth of more than 60 inches. The upper part is very dark brown, firm silty clay loam; the next part is brown, very dark brown, dark grayish brown, and very dark grayish brown, mottled, very firm silty clay; and the lower part is brown and grayish brown, mottled, firm silty clay loam. In places the subsoil has sand grains and pebbles.

Permeability and runoff are slow. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is medium acid. It is friable and can be easily tilled. 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 early spring.

Nearly all of the acreage is used for cultivated crops. This soil has medium potential for grain sorghum, soybeans, wheat, and range. It has low potential for septic tank absorption fields and dwellings and very high potential for sewage lagoons.

Wetness is a limitation if cultivated crops are grown. A surface drainage system is needed. If the soil is tilled when it is too wet, surface compaction is a problem. It can be minimized by timely tillage. 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 land capability classification is IIs, and the range site is Clay Upland.

Wm—Wymore silty clay loam, 1 to 4 percent slopes. This deep, gently sloping, moderately well drained soil is on broad ridgetops. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is very dark brown silty clay loam about 6 inches thick. The subsoil extends to a depth of more than 60 inches. The upper part is very dark brown, firm silty clay loam; the next part is brown, very dark brown, dark grayish brown, and very dark grayish brown, mottled, very firm silty clay; and the lower part is brown and grayish brown, mottled, firm silty clay loam. In some places the surface layer is silty clay. In other places the soil has a substratum of clay loam or clay that contains pebbles.

Included with this soil in mapping are small areas of the moderately deep Benfield soils on the upper side slopes. These soils make up about 10 percent of the map unit.

Permeability is slow in the Wymore soil, and runoff is medium. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is medium acid. It is friable and can be easily tilled. The shrink-swell potential is high in the subsoil. A perched seasonal high water table is at a depth of 1 to 3 feet in early spring.

Nearly all of the acreage is used for cultivated crops. This soil has medium potential for grain sorghum, soybeans, wheat, and range. It has low potential for septic tank absorption fields and dwellings and high potential for sewage lagoons.

Water erosion is a hazard if cultivated crops are grown. Reducing the number of tillage operations, planting winter cover crops, 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 surface crusting, and increase the rate of water infiltration.

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

Wn—Wymore silty clay loam, 4 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 100 acres in size.

Typically, the surface layer is very dark brown silty clay loam about 4 inches thick. The subsoil extends to a depth of more than 60 inches. The upper part is very dark brown, firm silty clay loam; the next part is brown, very dark brown, dark grayish brown, and very dark grayish brown, mottled, very firm silty clay; and the lower part is brown and grayish brown, mottled, firm silty clay loam. In some places the surface layer is silty clay. In other places the soil has a substratum of clay loam or clay that contains pebbles.

Included with this soil in mapping are small areas of the moderately deep Benfield soils on the lower side slopes. These soils make up about 10 percent of the map unit.

Permeability is slow in the Wymore soil, and runoff is medium. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is medium acid. It is friable and can be easily tilled. 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 early spring.

Nearly all of the acreage is used for cultivated crops. This soil has medium potential for grain sorghum, soybeans, wheat, and range. It has low potential for septic tank absorption fields and dwellings and high potential for sewage lagoons.

Water erosion is a hazard if cultivated crops are grown. Reducing the number of tillage operations, planting winter cover crops, 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 surface crusting, and increase the rate of water infiltration.

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

Ws—Wymore Variant fine sandy loam, 1 to 3 percent slopes. This deep, gently sloping, moderately well drained soil is on ridgetops and side slopes. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is very dark brown fine sandy loam about 12 inches thick. The subsurface layer is dark brown fine sandy loam about 5 inches thick. The subsoil is mottled, very firm silty clay about 25 inches thick. The upper part is dark grayish brown, and the lower part is brown. The substratum to a depth of about 60 inches is brown, mottled, firm silty clay loam. In places the surface layer is silt loam.

Included with this soil in mapping are small areas of the well drained Morrill and Ortello soils. These soils are on side slopes below the Wymore Variant soil. The subsoil of Morrill soils is redder and less clayey than that of the Wymore Variant soil. Ortello soils have a subsoil of fine sandy loam. Included soils make up about 15 percent of the map unit.

Permeability is slow in the Wymore Variant soil, and runoff is medium. Available water capacity is high. Organic matter content is moderate, and natural fertility is medium. The surface layer is neutral. It is friable and can be easily tilled. 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 early spring.

About 60 percent of the acreage is used for cultivated crops, and the rest is used as range or hayland. This soil has medium potential for grain sorghum, soybeans, wheat, and range. It has low potential for septic tank absorption fields and dwellings and very high potential for sewage lagoons.

If cultivated crops are grown, water erosion is a hazard and restricted root growth is a limitation. The clayey subsoil restricts the movement of air and water and the growth of roots and releases water slowly to plants. 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 surface crusting, and increase the rate of water infiltration.

The native vegetation in the areas used as range is dominantly big bluestem, little bluestem, and switchgrass. If the range is heavily used throughout the growing season, these grasses are replaced by less desirable plants, such as tall dropseed, Baldwin ironweed, and western ragweed. Grazing when the soil is too wet causes surface compaction, reduces the rate of water infiltration, and increases the runoff rate. A proper stocking rate, a scheduled deferment of grazing during the growing season, a uniform distribution of grazing, and restricted use during wet periods help to keep the range productive.

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

Zo—Zook silty clay loam, occasionally flooded. This deep, nearly level, poorly drained soil is on flood plains along the major rivers. Individual areas are irregular in shape and range from 20 to several hundred acres in size.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer also is black silty clay loam. It is about 23 inches thick. The subsoil is firm silty clay about 22 inches thick. The upper part is very dark gray, and the lower part is very dark gray and mottled. The substratum to a depth of about 60 inches is very dark gray, mottled silty clay. In places the surface layer and subsurface layer are silty clay.

Included with this soil in mapping are small areas of the well drained Eudora and Muir soils. These soils typically have a subsoil of silt loam. Eudora soils are on flood plains below the Zook soil. Muir soils are on terraces. Included soils make up about 10 percent of the map unit.

Permeability is slow in the Zook soil. Runoff also is slow. Available water capacity and organic matter content are high. Natural fertility is medium. The surface layer is slightly acid. It is friable and can be easily tilled. 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 winter and spring.

Nearly all of the acreage is used for cultivated crops. This soil has medium potential for grain sorghum, soybeans, and wheat and high potential for range. It has very low potential for septic tank absorption fields, dwellings, and sewage lagoons.

If cultivated crops are grown, flooding is a hazard and wetness is a limitation. In years of above average rainfall, the flooding delays planting and harvesting and causes some crop damage. It reduces yields in some years, but in other years the extra moisture may be beneficial. Overcoming the flooding hazard is difficult without major flood-control measures. 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 land capability classification is IIw, and the range site is Clay Lowland.

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 inputs 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 270,000 acres in the county, or nearly 50 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county, but most are in the Pawnee-Wymore, Paxico-Muir-Eudora, and Kennebec-Chase-Wabash associations, which are described under the heading "General Soil Map Units." About 203,000 acres of this prime farmland is used for crops. The chief crops grown on this land are winter wheat, grain sorghum, soybeans, and alfalfa hay. Corn is also grown on the bottom land.

The map units in the survey area that are considered prime farmland are listed in this section. 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 on the following list. Onsite evaluation is needed to determine whether or not the limitation has been overcome by corrective measures.

The map units that meet the soil requirements for prime farmland are:

Bd	Benfield silty clay loam, 2 to 5 percent slopes
Ce	Chase silty clay loam
Em	Elmont silty clay loam, 3 to 7 percent slopes
Eo	Elmont silty clay loam, 3 to 7 percent slopes, eroded
Eu	Eudora silt loam
Ex	Eudora-Kimo complex
Gm	Gymer silty clay loam, 3 to 8 percent slopes
Hn	Haynie very fine sandy loam, occasionally flooded
Kf	Kennebec silt loam, occasionally flooded
Km	Kimo silty clay
Mo	Morrill loam, 3 to 7 percent slopes
Mr	Morrill clay loam, 3 to 7 percent slopes, eroded
Mu	Muir silt loam
Op	Ortello fine sandy loam, 3 to 7 percent slopes
Pe	Pawnee clay loam, 1 to 3 percent slopes
Re	Reading silty clay loam
Sg	Sharpsburg silt loam, 1 to 4 percent slopes
Tu	Tully silty clay loam, 3 to 7 percent slopes
Wb	Wabash silty clay, occasionally flooded (where drained)
Wk	Wymore silty clay loam, 0 to 1 percent slopes
Wm	Wymore silty clay loam, 1 to 4 percent slopes
Wn	Wymore silty clay loam, 4 to 7 percent slopes
Ws	Wymore Variant fine sandy loam, 1 to 3 percent slopes

Zo Zook silty clay loam, occasionally flooded (where drained)

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.

Soil potential ratings were prepared to supplement some of the soil interpretations. The ratings are explained under the heading "Soil Potentials for Selected Uses." Soil potential ratings are given in each map unit description and in some of the tables.

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 potential and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

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

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

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

The soils in the survey area are assigned to various interpretive groups at the end of each map unit description and in some of the tables. The groups for each map unit also are shown in the section "Interpretive Groups," which follows the tables at the back of this survey.

Crops and Pasture

John C. Dark, 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 187,000 acres in Pottawatomie County, or nearly 34 percent of the total acreage, is used for cultivated crops or for hay. During the period 1971 to 1981, grain sorghum was grown on about 26 percent of the cropland, wheat on 17 percent, corn on 10 percent, soybeans on 5 percent, alfalfa on 9 percent, and other hay crops on 20 percent. The remaining 13 percent was used for other crops, such as oats, rye, and barley (*3*). The acreage used for soybeans nearly tripled during this period. The acreage used for oats and alfalfa decreased, and the acreage used for all other crops remained about the same.

The cropland in the county occurs mainly as areas of Chase, Elmont, Eudora, Gymer, Kennebec, Muir, Pawnee, Reading, Sharpsburg, Wabash, Wymore, and Zook soils. A smaller acreage of Haynie, Kimo, Morrill, Ortello, and Tully soils also is used as cropland.

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 Pottawatomie County are controlling erosion, maintaining fertility and tilth, and reducing wetness.

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 Benfield, Elmont, Gymer, Monona, Morrill, Ortello, Pawnee, Sharpsburg, Thurman, Tully, 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 Pawnee, Tully, 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 and conservation cropping systems help to control water erosion and soil blowing in Pottawatomie County. 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 that are 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. Drilled crops, such as small grain or grasses and legumes, are alternated with row crops in a conservation cropping system.

Terraces, diversions, grassed waterways, and contour farming are 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 generally should be used in combination with terraces. It is best suited to soils that have smooth, uniform slopes and are suitable for terracing.

Unless they have been limed, some of the soils in the county have a slightly acid or medium acid surface layer. Applications of lime can result in a neutral reaction. Legumes, such as alfalfa, grow better on neutral soils than on other soils. 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 and lime needed 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.

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 clay loam, silty clay loam, or 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.

A drainage system is a management need on some of the soils on flood plains. Unless drained by surface drains or a bedding system, some areas of Chase, Kimo, Wabash, and Zook soils are so wet that crop yields are reduced.

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 2 percent of the acreage in Pottawatomie County is pasture. Cool-season grasses, such as tall fescue and 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 reducing water loss.

Proper stocking rates help to maintain a good stand of grasses. The numbers of livestock should be adjusted to the expected level of yields. Forage and feed are provided to livestock during the entire growing season. About 40 pounds of forage per mature cow per day is needed if the pasture is grazed continuously throughout the growing season, and about 35 pounds per mature cow per day is needed if rotation grazing is used.

Delaying grazing in the spring until the soil is dry and firm helps to prevent the damage caused by trampling and compaction. Tall fescue and bromegrass should not be grazed during their 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 grazing periods 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 the pasture with herbicides help to control invading trees, brush, and broad-leaved weeds. The herbicide must 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 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. 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 are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that 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 5 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 limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

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

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

Kenneth L. Hladek, range conservationist, Soil Conservation Service, helped prepare this section.

About 287,500 acres in Pottawatomie County, or 52 percent of the total acreage, is range. More than 50 percent of agricultural income in the county is derived from the sale of livestock, principally cattle.

Cow-calf operations dominate, but yearling operations are fairly common in the western and eastern parts of the county. The range in these areas occurs as large, continuous tracts. Throughout the central third of the county, the range tends to occur as smaller tracts interspersed among larger areas of cropland.

Some livestock producers extend the grazing season through the use of cool-season pastures of bromegrass (fig. 11). The crop residue of grain sorghum supplements many cow-calf operations. During the winter hay and protein concentrates supplement the forage provided by range.

Soils strongly influence the potential natural plant community in any given area of the county. The soils and climate of the county can generally support tall grasses, such as big bluestem, little bluestem, indiangrass, and switchgrass. The isolated clayey soils interspersed throughout the nearly level uplands and the shallow, rocky soils on some of the steeper slopes, however, can support only the mixture of grasses that is more common in central Kansas.

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 6 shows, for nearly every soil, 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 use as rangeland are listed. An explanation of the column headings in table 6 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.

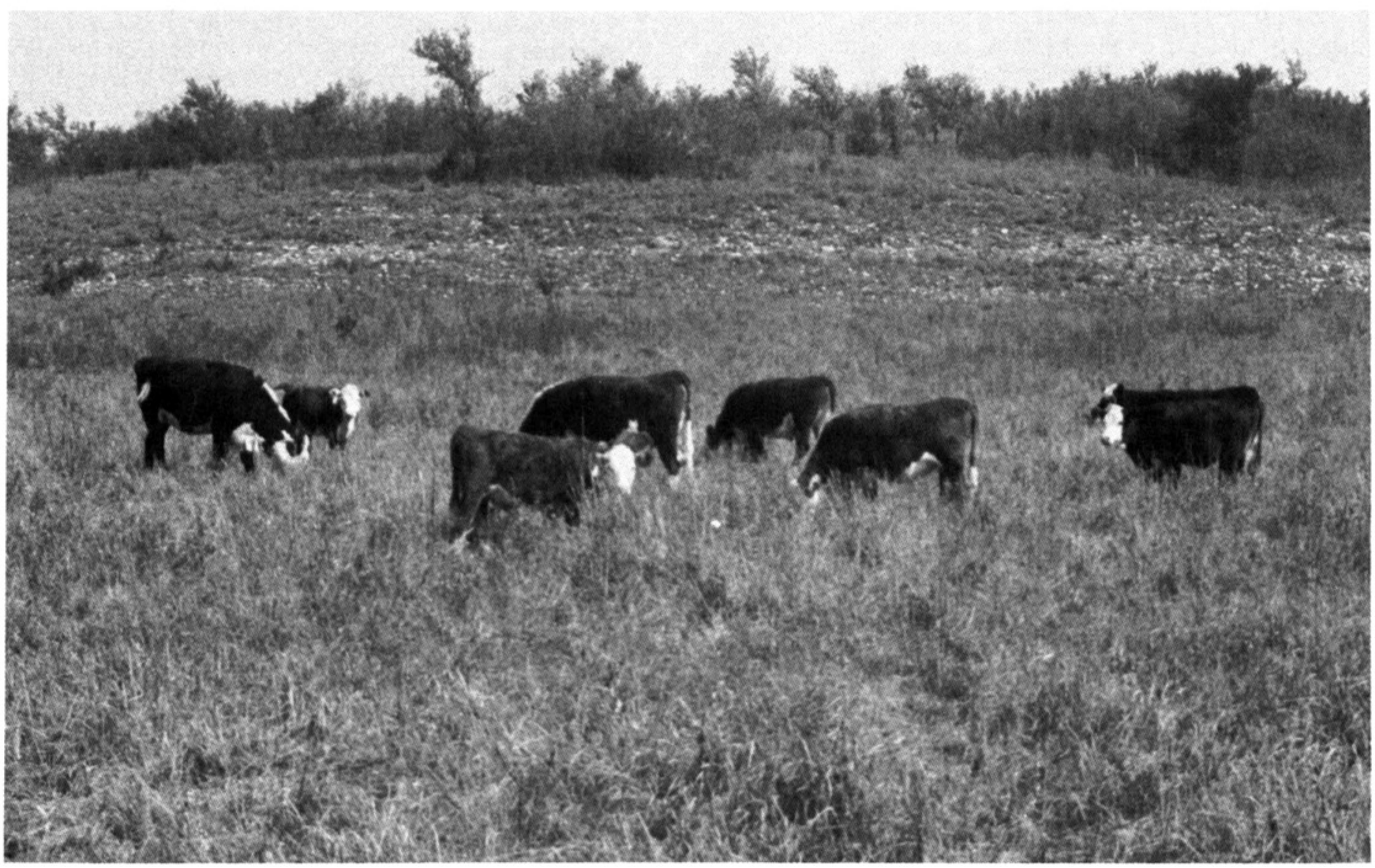


Figure 11.—A cool-season pasture of bromegrass used to supplement the forage provided by native grasses.

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—is 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.

Much of the range in the county has been well managed. Traditionally, a large part of it was burned in the spring. Fire has proved to be an effective means of controlling the invasion of brush on upland sites. Controlled grazing helps to maintain or increase the extent of the major plant species in the natural plant community.

Forage production has been significantly reduced in some areas because the range has been depleted by excessive, continuous grazing and the invasion of woody species. Proper grazing use, brush control, and measures that result in a uniform distribution of grazing are needed. The range can be improved by timely deferment of grazing and by a planned grazing system. Also, abandoned cropland can be reseeded.

Woodland Management and Productivity

Keith A. Ticknor, forester, Soil Conservation Service, assisted in preparing this section.

About 32,700 acres in Pottawatomie County, or nearly 6 percent of the total acreage, is forested. The forested acreage has decreased steadily in recent years, mainly because of the conversion of woodland to cropland or pasture. The woodland occurs as irregular tracts and narrow bands along streams and rivers, as strips in upland drainageways, and as irregular tracts on steep upland soils. The largest concentration of woodland is in the western third of the county.

The woodland is divided into three main forest cover types—bur oak, post oak-blackjack oak, and hackberry-American elm-green ash. The bur oak forest cover type is in areas of the Clime-Tully-Benfield and Wamego-Elmont associations on uplands. These associations are described under the heading "General Soil Map Units." On these dry upland sites, bur oak is associated with other species, such as bitternut hickory, green ash, hackberry, American elm, red elm, honeylocust, black locust, eastern redcedar, and eastern redbud. The understory plants are fragrant sumac, Ohio buckeye, common pricklyash, buckbrush, smooth sumac, and roughleaf dogwood. Chinkapin oak is commonly the dominant species on Tuttle soils, which are of minor extent in the Clime-Tully-Benfield association.

The post oak-blackjack oak forest cover type is in areas of the Morrill-Ortello and Pawnee-Morrill associations on uplands. Green ash, elms, hackberry, northern catalpa, black oak, Russian mulberry, and black locust are some of the associated species. Also, silver maple, eastern cottonwood, black walnut, and boxelder grow in the low areas. Some tracts in areas of the sandier soils are nearly pure stands of blackjack oak.

The hackberry-American elm-green ash forest cover type is in areas of the Paxico-Muir-Eudora and Kennebec-Chase-Wabash associations on bottom land. Bur oak is abundant in these areas. Other abundant species are black walnut, eastern cottonwood, honeylocust, Kentucky coffeetree, eastern redbud, boxelder, American sycamore, and wahoo.

Many of the trees, especially those on bottom land, can be used commercially for 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 7 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 7, *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 are also 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 1month. 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 *volume* number. 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 *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced on 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 Pottawatomie 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 environmental plantings.

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.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

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

Pottawatomie County has several areas of scenic, geologic, and historical interest. The western part 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 eastern part of the county is in the Nebraska and Kansas Loess-Drift Hills major land resource area. This area is characterized by rolling loess hills dissected by valleys that have meandering streams.

Several watershed lakes and many farm ponds and streams on privately owned land in the county provide opportunities for water sports (fig. 12). State park areas at the Tuttle Creek Reservoir and two state fishing lakes provide opportunities for fishing, camping, boating, and picnicking.

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil

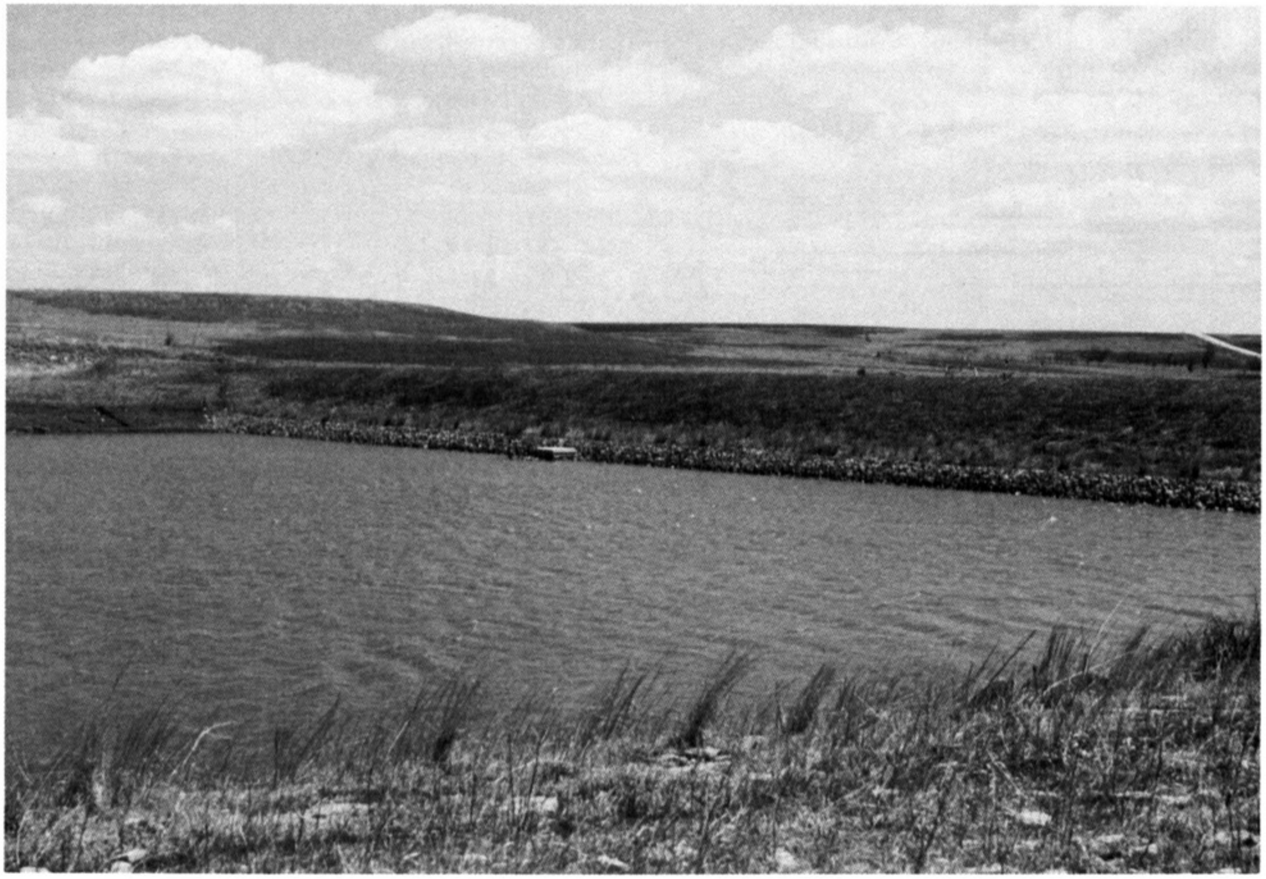


Figure 12.—A privately owned watershed lake in an area of Clime and Sogn soils.

properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

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

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

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

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

Wildlife Habitat

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

The primary game species in Pottawatomie County are bobwhite quail, prairie chicken, ring-necked pheasant, mourning dove, cottontail rabbit, fox squirrel, white-tailed deer, and several species of waterfowl.

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 conducive to a variety of wildlife species. Establishing additional fringe areas generally can increase the wildlife population.

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

Tuttle Creek Reservoir and other lakes, ponds, and streams provide good to excellent fishing. The species commonly caught are largemouth bass, bluegill, crappie, carp, channel catfish, and flathead catfish. Walleye, northern pike, white bass, and striped bass also are caught in the reservoir.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

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

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

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, 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 bluestems, switchgrass, indiangrass, goldenrod, ragweed, sunflowers, native legumes, wheatgrass, and grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, cottonwood, sycamore, elm, hackberry, black walnut, hickory, willow, green ash, 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 eastern redcedar, 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, prairie cordgrass, buttonbush, indigobush, cattails, 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 the shallow parts 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. The wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail rabbit, 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, redwing blackbirds, muskrat, mink, and beaver.

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

Technical assistance in planning wildlife areas and in determining the vegetation suitable for planting can be obtained from the local office of the Soil Conservation Service. Additional information and assistance 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. These ratings are supplemented with soil potential ratings for dwellings with basements, dwellings without basements, septic tank absorption fields, and sewage lagoons in tables 15, 16, 17, and 18.

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

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

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

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

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreational uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

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

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

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, 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 to 6 feet are not considered.

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

Sanitary Facilities

Table 12 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 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

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

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

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

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

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

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

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

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

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

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or 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 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

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

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

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

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

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

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

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

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

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

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

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

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

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

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas 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 reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of 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 Potentials for Selected Uses

Soil potential ratings indicate the relative suitability of a soil for a particular use compared with that of other soils in a given area. The production or performance level, the feasibility and relative cost of applying modern technology to minimize the effects of soil limitations, and the adverse effects of continuing limitations, if any, on social, economic, or environmental values are considered. The criteria used in developing soil potential ratings for a particular use are established specifically for the area to which the ratings apply. The criteria may be different in nearby areas, counties, groups of states, or regions. Thus, the rating assigned to a soil for a given use in one area may differ from the rating assigned to the same soil in another area.

The ratings are developed primarily for planning purposes and are not intended as recommendations for land use. They do not identify the most profitable land use. A soil having a high potential for both range and cropland, for example, may be much more profitably used for one purpose than for the other. The ratings help decision makers to determine the relative suitability of soils for a given use. They are used along with other resource information as a guide in making land use decisions. They supplement the land capability classes, woodland suitability groups, range sites, soil limitation ratings, and other soil interpretations in soil handbooks and technical guides. They may be substituted for these interpretations or may supplement them in inventories and evaluations, interim soil reports, watershed work plans, RC&D area plans, and river basin studies prepared by SCS or in reports released by conservation districts or other units of government.

Five rating classes are used to indicate the comparative potential of the soils for a given use. These classes are very high, high, medium, low, and very low. The paragraphs that follow define these rating classes.

Very high potential.—Production or performance meets or exceeds local standards because the soil properties are exceptionally favorable, installation or management costs are low, and there are no soil limitations.

High potential.—Production or performance meets or exceeds local standards; the cost of measures that can overcome soil limitations is favorable in relation to the expected performance or production; and the limitations continuing after corrective measures are applied do not appreciably detract from environmental quality or restrict economic returns.

Medium potential.—Production or performance is somewhat below local standards; the cost of measures that can overcome soil limitations is high; or the limitations continuing after corrective measures are applied detract from environmental quality or restrict economic returns.

Low potential.—Production or performance is significantly below local standards; the measures required to overcome soil limitations are very costly; or the limitations continuing after corrective measures are applied appreciably detract from environmental quality or restrict economic returns.

Very low potential.—Production or performance is much below local standards because of unfavorable soil properties; economically feasible measures to overcome severe soil limitations are unavailable; or the soil limitations continuing after corrective measures are applied seriously detract from environmental quality or restrict economic returns.

Tables 15 through 18 give soil potential ratings for dwellings with basements, dwellings without basements, septic tank absorption fields, and sewage lagoons. A soil potential index value is given after the verbal rating of each soil. This value is a numerical rating used to rank soils from very high to very low according to their potential for the specified use.

Soil Properties

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

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 22.

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

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

Engineering Index Properties

Table 19 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. 13). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

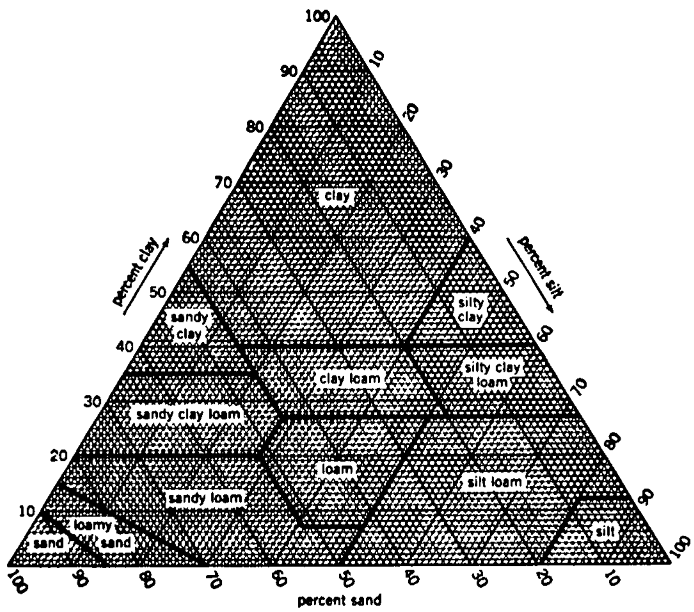


Figure 13.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

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

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

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

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

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

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

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

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

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

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

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

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

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

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

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 20 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 20 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 20, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

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

Soil and Water Features

Table 21 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

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

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

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

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

If a soil is assigned to two hydrologic groups in table 21, the first letter is for drained areas and the second is for undrained areas.

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 21 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; November-May, for example, means that flooding can occur during the period November through May.

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

Engineering Index Test Data

Table 22 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series described in the section "Soil Series and Their Morphology." The soil samples were tested by the Kansas Department of Transportation.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

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 23 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol.* An example is 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 dryness, 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. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine, 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. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*4*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*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."

Benfield Series

The Benfield series consists of moderately deep, well drained, slowly permeable soils on uplands. These soils formed in calcareous shale residuum. Slopes range from 2 to 7 percent.

Benfield soils are similar to Clime soils and are commonly adjacent to Clime, Pawnee, Tully, and Wymore soils. Clime soils are calcareous, do not have an argillic horizon, and are on side slopes. Pawnee, Tully, and Wymore soils are more than 40 inches deep. Pawnee and Wymore soils are in positions on the landscape similar to those of the Benfield soils. Tully soils are on foot slopes and the lower side slopes.

Typical pedon of Benfield silty clay loam, 2 to 5 percent slopes, 870 feet west and 240 feet south of the northeast corner of sec. 30, T. 7 S., R. 7 E.

A—0 to 6 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; strong fine granular structure; friable, hard; many fine roots; slightly acid; gradual smooth boundary.

BA—6 to 10 inches; dark brown (7.5YR 3/2) silty clay loam, brown (7.5YR 4/2) dry; moderate fine subangular blocky structure; firm, hard; many fine roots; neutral; gradual smooth boundary.

Bt1—10 to 18 inches; dark brown (7.5YR 3/2) silty clay, brown (7.5YR 4/2) dry; few fine faint brown (7.5YR 5/4) mottles; moderate fine subangular blocky structure; firm, very hard; common fine roots; thin discontinuous clay films on faces of peds; neutral; gradual smooth boundary.

Bt2—18 to 26 inches; reddish brown (5YR 4/3) silty clay, reddish brown (5YR 5/3) dry; few fine faint yellowish red (5YR 5/6) mottles; moderate medium subangular blocky structure; firm, very hard; few fine roots; thin discontinuous clay films on faces of peds; moderately alkaline; clear smooth boundary.

BC—26 to 30 inches; reddish brown (5YR 4/3) silty clay, reddish brown (5YR 5/3) dry; few fine prominent grayish brown (2.5Y 5/2) mottles; weak medium subangular blocky structure; firm, hard; few fine roots; weak effervescence; moderately alkaline; abrupt wavy boundary.

Cr—30 inches; calcareous shale.

The thickness of the solum and the depth to calcareous shale range from 20 to 40 inches. The thickness of the mollic epipedon ranges from 7 to 20 inches. The content of chert less than 3 inches in size ranges from 0 to 15 percent in the solum. Some pedons have carbonate concretions in the lower part of the solum.

The A horizon has hue of 7.5YR to 2.5Y, value of 2 or 3 (3 to 5 dry), and chroma of 1 or 2. It is silty clay loam, silt loam, loam, or the cherty analogs of these textures. It ranges from slightly acid to mildly alkaline.

The Bt horizon has hue of 5YR to 2.5Y, value of 3 to 5 (4 to 6 dry), and chroma of 2 to 6. It is silty clay, clay, silty clay loam, or the cherty analogs of these textures. It has a clay content of 35 to 45 percent. It ranges from neutral to moderately alkaline.

The BC horizon has hue of 5YR to 5Y, value of 4 to 6 (5 to 7 dry), and chroma of 2 to 4. The wide range of color is inherited from the varicolored shale. This horizon is silty clay loam, clay, silty clay, or the cherty analogs of these textures. It is mildly alkaline or moderately alkaline.

Chase Series

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

Chase soils are similar to Zook soils and are commonly adjacent to Kennebec, Reading, Wabash, and Zook soils. The poorly drained Zook and Wabash soils do not have an argillic horizon. They are in the slightly lower landscape positions. Kennebec and Reading soils are less clayey in the subsoil than the Chase soils. Kennebec soils do not have an argillic horizon. They are adjacent to the stream channels. Reading soils are on the higher terraces.

Typical pedon of Chase silty clay loam, 1,900 feet west and 1,050 feet north of the southeast corner of sec. 4, T. 9 S., R. 9 E.

Ap—0 to 7 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable, hard; few fine roots; neutral; abrupt smooth boundary.

A—7 to 16 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; moderate medium granular structure; friable, hard; few fine roots; neutral; clear smooth boundary.

BA—16 to 21 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; moderate fine subangular blocky structure; firm, hard; few fine roots; neutral; gradual smooth boundary.

Bt—21 to 43 inches; very dark brown (10YR 2/2) silty clay, dark grayish brown (10YR 4/2) dry; few fine faint brown (10YR 5/3) mottles; moderate medium blocky structure; very firm, very hard; few fine roots; thin discontinuous clay films on faces of peds; neutral; gradual smooth boundary.

BC—43 to 48 inches; very dark grayish brown (10YR 3/2) silty clay, grayish brown (10YR 5/2) dry; common fine distinct yellowish brown (10YR 5/4) mottles; weak medium blocky structure; firm, hard; very few fine roots; neutral; gradual smooth boundary.

C—48 to 60 inches; dark brown (10YR 3/3) silty clay loam, grayish brown (10YR 5/2) dry; common fine distinct yellowish brown (10YR 5/4) mottles; massive; firm, hard; neutral.

The thickness of the solum ranges from 36 to 60 inches. The mollic epipedon is more than 36 inches thick.

The A and Bt horizons range from medium acid to neutral. The A horizon has hue of 10YR, value of 2 or 3 (3 to 5 dry), and chroma of 1 or 2. It is silty clay loam or silt loam. 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 typically is silty clay, but the range includes silty clay loam and clay. The C horizon has the same color range as that of the Bt horizon. It is silty clay loam or silty clay. It ranges from slightly acid to moderately alkaline.

Clime Series

The Clime series consists of moderately deep, well drained, slowly permeable soils on uplands. These soils formed in material weathered from calcareous, clayey shale. Slopes range from 5 to 40 percent.

Clime soils are similar to Benfield soils and are commonly adjacent to Benfield, Sogn, Tully, and Wamego soils. Benfield soils have an argillic horizon. They are on ridgetops. The shallow Sogn soils are in the less sloping areas above the Clime soils. The deep Tully soils have a mollic epipedon that is thicker than that of the Clime soils. They are on foot slopes. The noncalcareous Wamego soils are on the mid and lower side slopes.

Typical pedon of Clime silty clay loam, in an area of Clime-Sogn silty clay loams, 5 to 20 percent slopes, 1,800 feet east and 1,600 feet south of the northwest corner of sec. 17, T. 8 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; moderate fine granular structure; firm, hard; about 1 percent limestone fragments less than 0.5 inch in diameter; many fine and medium roots; strong effervescence; moderately alkaline; clear smooth boundary.

Bw—8 to 12 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) and light brownish gray (2.5Y 6/2) dry; moderate fine subangular blocky structure; firm, very hard; about 10 percent limestone fragments less than 0.5 inch in diameter; many fine and medium roots; violent effervescence; moderately alkaline; clear smooth boundary.

BC—12 to 16 inches; grayish brown (2.5Y 5/2) and dark grayish brown (2.5Y 4/2) silty clay loam, light brownish gray (2.5Y 6/2) and grayish brown (2.5Y 5/2) dry; moderate fine subangular blocky structure; firm, very hard; about 1 percent limestone fragments less than 0.5 inch in diameter; common fine roots; violent effervescence; moderately alkaline; clear smooth boundary.

C—16 to 26 inches; grayish brown (2.5Y 5/2) silty clay loam, light gray (2.5Y 7/2) dry; moderate fine subangular blocky structure; firm, very hard; few fine roots; violent effervescence; moderately alkaline; gradual smooth boundary.

Cr—26 inches; calcareous shale.

The thickness of the solum ranges from 12 to 30 inches. The depth to shale ranges from 20 to 40 inches. The mollic epipedon ranges from 7 to 20 inches in thickness. The depth to free carbonates ranges from 0 to 10 inches. The soils generally are mildly alkaline or moderately alkaline throughout. In some pedons, however, they are neutral in the upper 10 inches.

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. It is silty clay, silty clay loam, or the stony analogs of these textures. The content of limestone fragments 3 inches to 2 feet in diameter ranges from 0 to 5 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, 2.5Y, or 5Y, value of 4 to 6 (5 to 7 dry), and chroma of 2 to 4. It is mottled in some pedons. It is clay, silty clay, silty clay loam, or the shaly analogs of these textures. The content of shale fragments is less than 10 percent in this horizon.

Elmont Series

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

Elmont soils are similar to Gymer and Sharpsburg soils and are commonly adjacent to Kennebec, Pawnee, Wamego, and Wymore soils. Gymer and Sharpsburg soils are more clayey in the subsoil than the Elmont soils. They formed in loess. Gymer soils are on the sides of valleys along the major rivers. Sharpsburg soils are on ridgetops. Kennebec soils do not have an argillic horizon. They are on flood plains. Pawnee, Wamego, and Wymore soils are on ridgetops and the upper side slopes. Pawnee and Wymore soils have a clayey subsoil. Wamego soils are moderately deep.

Typical pedon of Elmont silty clay loam, 3 to 7 percent slopes, 1,600 feet east and 200 feet south of the northwest corner of sec. 22, T. 7 S., R. 11 E.

Ap—0 to 5 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; friable, slightly hard; common fine roots; neutral; abrupt smooth boundary.

A—5 to 10 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; friable, slightly hard; common fine roots; neutral; gradual smooth boundary.

Bt1—10 to 14 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 4/3) dry; common fine distinct strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; firm, hard; few fine roots; thin discontinuous clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt2—14 to 26 inches; dark brown (10YR 4/3) silty clay loam, brown (7.5YR 5/4) dry; common fine distinct strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; firm, hard; few fine roots; thin discontinuous clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt3—26 to 46 inches; brown (7.5YR 4/4) silty clay loam, light yellowish brown (10YR 6/4) dry; many fine prominent red (2.5YR 4/6) and strong brown (7.5YR 5/6) mottles; some dark brown (7.5YR 3/4) faces of peds; weak medium subangular blocky structure; firm, hard; very few fine roots; thin discontinuous clay films on faces of peds; few fine dark soft accumulations; few dark stains; neutral; clear smooth boundary.

BC—46 to 50 inches; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) silty clay loam, light yellowish brown (10YR 6/4) and yellow (10YR 7/6) dry; some dark yellowish brown (10YR 3/4) faces of peds; weak medium subangular blocky structure; firm, hard; few dark coatings and accumulations; neutral; clear smooth boundary.

Cr—50 inches; interbedded sandy and silty shale.

The solum ranges from 30 to 60 inches in thickness. It is strongly acid to neutral. The depth to weathered shale bedrock ranges from 40 to more than 60 inches. The mollic epipedon is 10 to 24 inches thick.

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 typically is silty clay loam, but the range includes clay loam, loam, and silt loam.

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

The C horizon, if it occurs, 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 these colors. It is silty clay loam or clay loam.

Eudora Series

The Eudora series consists of deep, well drained, moderately permeable soils on stream terraces along the major river valleys. These soils formed in silty alluvium. Slopes are 0 to 1 percent.

Eudora soils are similar to Muir soils and are commonly adjacent to Haynie, Muir, Kimo, and Sarpy soils. Muir soils are more clayey in the subsoil than the Eudora soils, have a thicker mollic epipedon, and are on higher stream terraces. The calcareous Haynie soils and the sandy Sarpy soils are on flood plains. The somewhat poorly drained Kimo soils are in the slightly lower positions on the terraces. They typically are clayey in the upper part and silty in the lower part.

Typical pedon of Eudora silt loam, 3,500 feet west and 300 feet north of the southeast corner of sec. 2, T. 10 S., R. 11 E.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable, slightly hard; many fine roots; slightly acid; clear smooth boundary.

A—6 to 11 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; friable, slightly hard; common fine roots; slightly acid; clear smooth boundary.

AC—11 to 15 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak medium granular structure; friable, slightly hard; common fine roots; slightly acid; clear smooth boundary.

C1—15 to 33 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; massive; very friable, slightly hard; few fine roots; neutral; gradual smooth boundary.

C2—33 to 45 inches; brown (10YR 4/3) very fine sandy loam, pale brown (10YR 6/3) dry; massive; very friable, slightly hard; few fine roots; moderately alkaline; abrupt smooth boundary.

C3—45 to 54 inches; brown (10YR 5/3) silt loam, pale brown (10YR 6/3) dry; massive; very friable, slightly hard; few fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

C4—54 to 60 inches; brown (10YR 5/3) very fine sandy loam, pale brown (10YR 6/3) dry; massive; very friable, slightly hard; few fine roots; strong effervescence; moderately alkaline.

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

The A horizon has hue of 10YR, value of 2 or 3 (3 to 5 dry), and chroma of 1 or 2. It is silt loam, loam, or very fine sandy loam. It ranges from slightly acid to mildly alkaline.

The C horizon has hue of 10YR, 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 with varying textures. Faint mottles are below a depth of 30 inches in some pedons. This horizon ranges from neutral to moderately alkaline.

Florence Series

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

Florence soils are commonly adjacent to Benfield, Clime, and Tully soils. The content of chert fragments is less than 20 percent in the solum of the Benfield and

Tully soils. The moderately deep Benfield soils are on ridgetops. The deep Tully soils are on foot slopes. Clime soils are calcareous and do not have an argillic horizon. They are on the upper side slopes.

Typical pedon of Florence cherty silty clay loam, in an area of Benfield-Florence complex, 3 to 15 percent slopes, 550 feet south and 10 feet west of the northeast corner of sec. 28, T. 7 S., R. 8 E.

A1—0 to 6 inches; very dark brown (10YR 2/2) cherty silty clay loam, very dark grayish brown (10YR 3/2) dry; moderate fine granular structure; friable, slightly hard; many fine and medium roots; about 20 percent chert fragments 0.25 inch to 2.0 inches in diameter; neutral; clear smooth boundary.

A2—6 to 14 inches; very dark brown (10YR 2/2) very cherty silty clay loam, very dark grayish brown (10YR 3/2) dry; moderate fine and medium granular structure; friable, slightly hard; many fine and medium roots; about 40 percent chert fragments 0.25 inch to 4.0 inches in diameter; neutral; clear smooth boundary.

Bt1—14 to 32 inches; dark reddish brown (5YR 3/3) very cherty silty clay, reddish brown (5YR 4/3) dry; moderate fine subangular blocky structure; firm, hard; many fine roots; thin discontinuous clay films on faces of peds; about 55 percent chert fragments as much as 6 inches in diameter; slightly acid; clear smooth boundary.

Bt2—32 to 42 inches; dark reddish brown (5YR 3/3) very cherty silty clay, reddish brown (5YR 4/3) dry; moderate fine and medium subangular structure; firm, hard; common fine roots; thin discontinuous clay films on faces of peds; about 50 percent chert fragments as much as 10 inches in diameter; few fine soft calcium carbonate masses; mildly alkaline; clear wavy boundary.

R—42 inches; cherty limestone.

The thickness of the solum and the depth to bedrock range 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 these textures. It is medium acid to neutral.

The Bt horizon has hue of 2.5YR to 7.5YR, value of 3 to 5 (moist and dry), and chroma of 3 to 6. In some pedons it has mottles with higher chroma. It is cherty clay, very cherty clay, cherty silty clay, or very cherty silty clay. It is 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 uplands. These soils formed in reddish brown loess. Slopes range from 3 to 8 percent.

Gymer soils are similar to Elmont and Sharpsburg soils and are commonly adjacent to Clime, Tully, and Wamego soils. Elmont soils are less clayey in the subsoil than the Gymer soils. They formed in noncalcareous shale residuum. They are in positions on the landscape similar to those of the Gymer soils. Sharpsburg soils have a subsoil that is browner than that of the Gymer soils. They are on ridgetops. The moderately deep, calcareous Clime soils are on the upper side slopes. Tully soils have a dark surface layer that is thicker than that of the Gymer soils. They are on side slopes. The moderately deep Wamego soils are on ridgetops and the upper side slopes.

Typical pedon of Gymer silty clay loam, 3 to 8 percent slopes, 1,920 feet east and 100 feet north of the center of sec. 27, T. 9 S., R. 11 E.

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

AB—6 to 11 inches; dark brown (7.5YR 3/2) silty clay loam, brown (7.5YR 4/2) dry; moderate medium granular structure; firm, hard; many fine roots; slightly acid; gradual smooth boundary.

Bt1—11 to 19 inches; dark brown (7.5YR 3/4) silty clay loam, brown (7.5YR 4/4) dry; moderate fine subangular blocky structure; firm, hard; common fine roots; thin discontinuous clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt2—19 to 29 inches; reddish brown (5YR 4/4) silty clay loam, reddish brown (5YR 5/4) dry; some dark reddish brown (5YR 3/4) faces of peds; moderate medium subangular blocky structure; firm, hard; common fine roots; thin discontinuous clay films on faces of peds; slightly acid; gradual smooth boundary.

BC—29 to 43 inches; reddish brown (5YR 4/4) silty clay loam, reddish brown (5YR 5/4) dry; weak medium subangular blocky structure; firm, hard; common fine roots; slightly acid; gradual smooth boundary.

C—43 to 60 inches; reddish brown (5YR 4/4) silty clay loam, reddish brown (5YR 5/4) dry; massive; friable, hard; few fine roots; slightly acid.

The solum ranges from 36 to 60 inches in thickness. It is slightly acid to strongly acid in the upper part and slightly acid or medium acid in the lower part. The mollic epipedon ranges from 10 to 20 inches in thickness.

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 silt loam or silty clay loam. The Bt horizon has hue of 5YR or 7.5YR, value of 3 to 5 (4 to 6 dry), and chroma of 3 to 6. It is silty clay loam or silty clay. It has a clay content of 35 to 42 percent in the upper 20 inches. 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, moderately well drained, moderately permeable soils on flood plains. These soils formed in calcareous, silty alluvium. Slopes are 0 to 1 percent.

Haynie soils are commonly adjacent to Eudora, Muir, Paxico, and Sarpy soils. Eudora soils are noncalcareous to a depth of 20 inches and have a mollic epipedon. They are on low stream terraces. Muir soils have a mollic epipedon that is more than 20 inches thick. They are on stream terraces. The somewhat poorly drained Paxico soils are mottled within 20 inches of the surface. They are on flood plains adjacent to river channels. The sandy Sarpy soils are in positions on the landscape similar to those of the Haynie soils.

Typical pedon of Haynie very fine sandy loam, occasionally flooded, 1,200 feet north and 400 feet west of the southeast corner of sec. 15, T. 10 S., R. 12 E.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) very fine sandy loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable, slightly hard; many fine roots; mildly alkaline; abrupt smooth boundary.

A—6 to 9 inches; very dark grayish brown (10YR 3/2) very fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable, hard; common fine roots; slight effervescence; mildly alkaline; gradual smooth boundary.

C1—9 to 38 inches; brown (10YR 5/3) silt loam, pale brown (10YR 6/3) dry; weak fine granular structure; friable, slightly hard; common fine roots; common lenses of very fine sandy loam 0.25 inch thick; strong effervescence; moderately alkaline; diffuse smooth boundary.

C2—38 to 47 inches; brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; massive; friable, slightly hard; few fine roots; common lenses of very fine sandy loam 0.25 inch thick; strong effervescence; moderately alkaline; diffuse smooth boundary.

C3—47 to 60 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; few fine distinct yellowish brown (10YR 5/8) mottles; massive; friable, slightly hard; few fine roots; violent effervescence; moderately alkaline.

The thickness of the solum is less than 10 inches and corresponds to the thickness of the surface soil. The depth to free carbonates ranges from 0 to 10 inches.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3 (4 or 5 dry), and chroma of 2 or 3. It is silt loam, silty clay loam, or very fine sandy loam. It is mildly alkaline or moderately 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 in some pedons it has strata of fine sandy loam and loamy fine sand. This horizon has few to common stains and mottles throughout. Most of the mottles have hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 4 to 8.

Kennebec Series

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

Kennebec soils are commonly adjacent to Chase, Reading, Tully, and Wabash soils. The somewhat poorly drained Chase and poorly drained Wabash soils have more clay in the subsoil than the Kennebec soils. Chase soils are on stream terraces. Wabash soils are on the flood plains but are farther from the stream channels than the Kennebec soils. Reading and Tully soils have an argillic horizon. Reading soils are on stream terraces, and Tully soils are on foot slopes.

Typical pedon of Kennebec silt loam, occasionally flooded, 700 feet east and 2,450 feet south of the northwest corner of sec. 11, T. 8 S., R. 12 E.

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

A1—6 to 16 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate medium granular structure; friable, slightly hard; common fine roots; slightly acid; gradual smooth boundary.

A2—16 to 42 inches; black (10YR 2/1) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; friable, hard; few fine roots; slightly acid; diffuse smooth boundary.

AC—42 to 54 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak medium granular structure; friable, hard; few fine roots; common fine and medium sand grains; neutral; diffuse smooth boundary.

C—54 to 60 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; massive; friable, hard; very few fine roots; many fine and medium sand grains; neutral.

The solum and the mollic epipedon are more than 36 inches thick. The depth to free carbonates typically is more than 60 inches. The solum ranges from medium acid to neutral.

The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 1 or 2. It typically is silt loam, but in some pedons it is silty clay loam. The C horizon has hue of 10YR or 2.5Y, value of 3 or 4 (4 to 6 dry), and chroma of 1 or 2. It is mottled in some pedons. It typically is silt loam or silty clay loam, but the content of clay and sand varies below a depth of 40 inches.

Kimo Series

The Kimo series consists of deep, somewhat poorly drained soils on stream terraces along the major rivers. These soils formed in old clayey alluvium over lighter colored, silty alluvium. Permeability is slow in the upper part of the profile and moderate in the lower part. Slopes are 0 to 1 percent.

Kimo soils are commonly adjacent to Eudora and Muir soils. The adjacent soils have less clay in the control section than the Kimo soils and do not have a contrasting texture in the substratum. They are on stream terraces.

Typical pedon of Kimo silty clay, 550 feet west and 1,950 feet north of the southeast corner of sec. 1, T. 10 S., R. 11 E.

Ap1—0 to 4 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate fine granular structure; firm, hard; common fine roots; slightly acid; abrupt smooth boundary.

Ap2—4 to 9 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate fine subangular blocky; firm, hard; common fine roots; neutral; abrupt smooth boundary.

A1—9 to 18 inches; very dark grayish brown (10YR 3/2) silty clay, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; firm, hard; common fine roots; mildly alkaline; clear smooth boundary.

A2—18 to 22 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; few fine distinct black (10YR 2/1) mottles; weak medium subangular blocky structure; firm, hard; few fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

2C1—22 to 33 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; few fine distinct yellowish brown (10YR 5/4) and few fine distinct black (10YR 2/1) mottles; massive; friable; slightly hard; few fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

2C2—33 to 42 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; common fine distinct dark yellowish brown (10YR 3/6) mottles; massive; friable, slightly hard; few fine roots; sand lenses at a depth of about 42 inches; strong effervescence; moderately alkaline; abrupt smooth boundary.

2C3—42 to 60 inches; stratified very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) dry; common fine prominent dark yellowish brown (10YR 3/6) mottles; massive; firm, hard; very few fine roots; strong effervescence; moderately alkaline.

The depth to the 2C horizon ranges from 16 to 36 inches. The mollic epipedon ranges from 16 to 24 inches in thickness.

The A horizon has hue of 10YR, value of 2 to 4 (4 or 5 dry), and chroma of 1 or 2. It is silty clay loam or silty clay. In many pedons the fine textured material near the contact with the 2C horizon has some mottles with higher chroma. The 2C horizon has hue of 10YR, 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. In this horizon, the content of clay is less than 18 percent and the content of fine sand and coarse sand is less than 15 percent. Thin strata of finer or coarser textured material are in some pedons.

Monona Series

The Monona series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loess. Slopes range from 5 to 10 percent.

Monona soils are commonly adjacent to Clime, Muir, and Tully soils. The moderately deep, calcareous Clime soils are on the upper side slopes. Muir soils have a mollic epipedon that is more than 20 inches thick. They are on stream terraces. Tully soils have a clayey subsoil. They are on side slopes above the Monona soils.

Typical pedon of Monona silt loam, 5 to 10 percent slopes, 2,700 feet north and 1,200 feet west of the southeast corner of sec. 32, T. 9 S., R. 8 E.

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

A—4 to 10 inches; very dark brown (10YR 2/2) silt loam, dark brown (10YR 3/3) dry; strong medium granular structure; friable, slightly hard; many fine and medium roots; common worm casts; slightly acid; clear smooth boundary.

AB—10 to 14 inches; dark grayish brown (10YR 4/2) silt loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; friable, hard; many fine and medium roots; common worm casts; slightly acid; gradual smooth boundary.

Bw—14 to 30 inches; dark brown (7.5YR 4/4) silt loam, brown (7.5YR 5/4) dry; few fine faint dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; friable, hard; many fine roots; few worm casts; neutral; diffuse smooth boundary.

C—30 to 60 inches; brown (7.5YR 5/4) silt loam, light brown (7.5YR 6/4) dry; few fine faint reddish brown (5YR 5/4) mottles; massive; friable, hard; few fine and very fine roots; neutral.

The thickness of the solum ranges from 25 to 42 inches. Free carbonates are below a depth of 2 feet in some pedons. The mollic epipedon ranges from 7 to 20 inches in thickness.

The A horizon has hue of 10YR, value of 2 or 3 (3 to 5 dry), and chroma of 1 to 3. It typically is slightly acid but in some pedons is medium acid. The Bw horizon has hue of 10YR or 7.5YR, value of 4 or 5 (4 to 6 dry), and chroma of 3 or 4. It is neutral or slightly acid. The C horizon has colors similar to those of the Bw horizon. It ranges from neutral to moderately alkaline.

Morrill Series

The Morrill series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loamy till or outwash deposits. Slopes range from 3 to 20 percent.

Morrill soils are commonly adjacent to Ortello, Pawnee, Sharpsburg, and Wymore soils. Ortello soils have more sand in the subsoil than the Morrill soils. They are on the lower side slopes. Pawnee, Sharpsburg, and Wymore soils have a clayey subsoil. They are on ridgetops and the upper side slopes.

Typical pedon of Morrill loam, 3 to 7 percent slopes, 2,000 feet east and 1,950 feet north of the southwest corner of sec. 23, T. 9 S., R. 9 E.

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

BA—10 to 13 inches; dark reddish brown (5YR 3/3) loam, reddish brown (5YR 4/3) dry; moderate fine subangular blocky structure; friable, slightly hard; many fine roots; medium acid; gradual smooth boundary.

Bt—13 to 24 inches; reddish brown (5YR 4/4) clay loam, yellowish red (5YR 4/6) dry; moderate medium subangular blocky structure; firm, hard; common fine roots; thin discontinuous clay films on faces of peds; slightly acid; diffuse smooth boundary.

BC—24 to 34 inches; yellowish red (5YR 4/6) clay loam, yellowish red (5YR 5/6) dry; weak medium subangular blocky structure; friable, hard; few pebbles; common fine roots; slightly acid; gradual smooth boundary.

C—34 to 60 inches; yellowish red (5YR 4/6) clay loam, yellowish red (5YR 5/6) dry; massive; friable, hard; few pebbles; very few fine roots; slightly acid.

The thickness of the solum ranges from 30 to 60 inches. The soils are neutral to strongly acid throughout. The mollic epipedon ranges from 10 to 24 inches in thickness.

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 commonly is loam or clay loam but in some pedons is 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. It has a clay content of 25 to 35 percent. The content of pebbles in this horizon ranges from 0 to 20 percent.

The C horizon has hue of 10YR, 7.5YR, or 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.

Muir Series

The Muir series consists of deep, well drained, moderately permeable soils on stream terraces. These soils formed in silty alluvium. Slopes are 0 to 1 percent.

Muir soils are similar to Eudora and Reading soils and are commonly adjacent to Eudora, Haynie, Kimo, and Zook soils. Eudora soils have a mollic epipedon that is thinner than that of the Muir soils and are less clayey in the subsoil. They commonly are on the lower stream terraces. Reading soils have an argillic horizon. They are on terraces along creeks. The calcareous Haynie soils are less clayey in the subsoil than the Muir soils. They are on flood plains. The somewhat poorly drained Kimo soils also are on flood plains. They typically are clayey in the upper part and silty in the lower part. The poorly drained Zook soils are more clayey throughout than the Muir soils. They are in positions on the landscape similar to those of the Muir soils.

Typical pedon of Muir silt loam, 6,000 feet west and 2,950 feet north of the southeast corner of sec. 30, T. 9 S., R. 8 E.

Ap—0 to 5 inches; very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable, slightly hard; many fine roots; neutral; abrupt smooth boundary.

A—5 to 22 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable, slightly hard; common fine roots; neutral; gradual smooth boundary.

Bw—22 to 44 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; friable, slightly hard; few fine roots; neutral; gradual smooth boundary.

C—44 to 60 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; massive; friable, slightly hard; neutral.

The solum ranges from 24 to 55 inches in thickness. The thickness of the mollic epipedon ranges from 20 to more than 40 inches. The soils are medium acid to mildly alkaline silt loam or silty clay loam throughout.

The A horizon has hue of 10YR, value of 2 or 3 (4 or 5 dry), and chroma of 1 or 2. The B horizon has hue of 10YR, value of 2 to 4 (4 to 6 dry), and chroma of 2 or 3. The C horizon has hue of 10YR, value of 2 to 4 (4 to 6 dry), and chroma of 2 to 4.

Ortello Series

The Ortello series consists of deep, well drained, moderately rapidly permeable soils on uplands. These soils formed in loamy and sandy eolian deposits. Slopes range from 3 to 12 percent.

Ortello soils are similar to Thurman soils and are commonly adjacent to Morrill, Thurman, Pawnee, Wann, and Wymore soils. Thurman soils are on the lower side slopes. They have more sand in the control section than the Ortello soils. Morrill soils are on side slopes above the Ortello soils. Their subsoil is dominantly clay loam. Pawnee and Wymore soils are on ridgetops and the upper side slopes. The subsoil of Pawnee soils is dominantly clay. Wymore soils are less sandy throughout the solum than the Ortello soils. The somewhat poorly drained Wann soils are on flood plains.

Typical pedon of Ortello fine sandy loam, 3 to 7 percent slopes, 1,900 feet west and 700 feet north of the southeast corner of sec. 34, T. 9 S., R. 9 E.

A1—0 to 5 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable, slightly hard; many fine roots; slightly acid; clear smooth boundary.

A2—5 to 10 inches; very dark brown (10YR 2/2) fine sandy loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; very friable, slightly hard; many fine roots; slightly acid; clear smooth boundary.

AB—10 to 19 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular structure; friable, slightly hard; many fine roots; slightly acid; clear smooth boundary.

Bw—19 to 27 inches; dark yellowish brown (10YR 3/4) fine sandy loam, dark yellowish brown (10YR 4/4) dry; weak fine subangular structure; friable, slightly hard; common fine roots; slightly acid; gradual smooth boundary.

C—27 to 60 inches; dark yellowish brown (10YR 4/4) loamy fine sand, yellowish brown (10YR 5/4) dry; single grained; very friable, slightly hard; few fine roots; neutral.

The solum ranges from 24 to 50 inches in thickness. It is slightly acid or neutral. The mollic epipedon ranges from 10 to 20 inches in thickness. Free carbonates generally are below a depth of 60 inches.

The A horizon has hue of 10YR, value of 2 or 3 (3 to 5 dry), and chroma of 1 to 3. It typically is fine sandy loam, but the range includes loam, very fine sandy loam, and loamy fine sand. The Bw horizon has hue of 10YR, value of 3 or 4 (4 to 6 dry), and chroma of 2 to 4. It is fine sandy loam or sandy loam. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6 (6 to 8 dry), and chroma of 2 to 4. It typically is loamy fine sand, but the range includes fine sand and loamy sand. This horizon is neutral or mildly alkaline.

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 6 percent.

Pawnee soils are similar to Tully and Wymore soils and are commonly adjacent to Morrill, Wamego, and Wymore soils. Tully and Wymore soils have less sand in the control section than the Pawnee soils. Tully soils are on foot slopes. Wymore soils are higher on the landscape than the Pawnee soils. Morrill soils are less clayey in the subsoil than the Pawnee soils. Also, they are typically lower on the landscape. The moderately deep Wamego soils are on the mid and lower side slopes.

Typical pedon of Pawnee clay loam, 3 to 6 percent slopes, 2,400 feet north and 600 feet east of the southwest corner of sec. 4, T. 9 S., R. 10 E.

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

BA—10 to 15 inches; dark brown (10YR 3/3) clay loam, brown (10YR 4/3) dry; common fine faint dark yellowish brown (10YR 4/4) mottles; moderate fine and medium subangular blocky structure; firm, hard; common fine roots; slightly acid; clear smooth boundary.

Bt1—15 to 26 inches; dark yellowish brown (10YR 4/4) clay, yellowish brown (10YR 5/4) dry; common fine distinct dark yellowish brown (10YR 4/6) and grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm, very hard; few fine roots; thin discontinuous clay films on faces of peds; few pebbles; few brown stains; neutral; gradual smooth boundary.

Bt2—26 to 38 inches; yellowish brown (10YR 5/4) clay, pale brown (10YR 6/3) dry; many medium distinct yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm, very hard; few fine roots; thin discontinuous clay films on faces of peds; few pebbles; few brown stains; moderately alkaline; gradual smooth boundary.

Bt3—38 to 42 inches; yellowish brown (10YR 5/4) clay, light yellowish brown (10YR 6/4) dry; many medium distinct yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) mottles; weak medium blocky structure; firm, very hard; very few fine roots; thin discontinuous clay films on faces of peds; few pebbles; common brown stains; moderately alkaline; gradual smooth boundary.

C—42 to 60 inches; mixed light olive brown (2.5Y 5/4) and grayish brown (2.5Y 5/2) clay loam, light yellowish brown (2.5Y 6/4) and light gray (2.5Y 7/2) dry; many medium distinct yellowish brown (10YR 5/6) mottles; massive; firm, hard; few pebbles; common brown stains; slight effervescence; moderately alkaline.

The solum ranges from 40 to 60 inches in thickness. It generally is noncalcareous. In some pedons, however, the lower part of the Bt horizon has a few calcium carbonate concretions. The mollic epipedon ranges from 10 to 19 inches in thickness. In some pedons the Bt and C horizons have few to common pebbles. Reaction is 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 C horizon.

The A horizon has hue of 10YR, value of 2 or 3 (3 to 5 dry), and chroma of 1 or 2. It typically is clay loam, but the range includes silty clay loam, loam, and clay. The Bt horizon has hue of 10YR to 5Y, value of 3 to 5 (3 to 7 dry), and chroma of 2 to 4. The C horizon has hue of 2.5Y or 5Y or is neutral in hue. It has value of 5 or 6 and chroma of 0 to 4. It typically is clay loam, but in some pedons it is sandy clay loam.

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.

Paxico soils are commonly adjacent to Haynie and Sarpy soils. The moderately well drained Haynie soils are farther away from the river channels than the Paxico soils. The excessively drained Sarpy soils are more sandy than the Paxico soils. They are in positions on the landscape similar to those of the Paxico soils.

Typical pedon of Paxico silt loam, frequently flooded, 4,500 feet south and 3,950 feet west of the northeast corner of sec. 15, T. 10 S., R. 8 E.

A—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; few fine strata that are lighter in color; weak fine granular structure; friable, slightly hard; common fine roots; slight effervescence; moderately alkaline; clear smooth boundary.

C1—9 to 19 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; few fine strata that are lighter in color; common medium distinct dark yellowish brown (10YR 4/6) mottles; massive; friable, slightly hard; few fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—19 to 42 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; few medium strata of fine sandy loam; common fine distinct dark yellowish brown (10YR 4/6) mottles; massive; friable, slightly hard; very few fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

2C—42 to 60 inches; dark grayish brown (10YR 4/2) loamy fine sand, light brownish gray (10YR 6/2) dry; thin strata of finer or coarser textured sediments; single grained; very friable, soft; few fine roots; strong effervescence; moderately alkaline.

The solum is less than 10 inches thick. The depth to carbonates ranges from 0 to 10 inches. Most pedons have free carbonates. The depth to sandy material ranges from 40 to more than 60 inches.

The A horizon has hue of 10YR, value of 2 to 4 (4 to 6 dry), and chroma of 1 or 2. It is silt loam or fine sandy loam. It is neutral to moderately alkaline.

The C horizon has hue of 10YR, 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 slightly alkaline or moderately alkaline. Common, fine and medium, dark yellowish brown or yellowish brown mottles are in most pedons.

The 2C horizon has hue of 10YR, value of 2 to 6 (4 to 7 dry), and chroma of 1 to 3. It is loamy fine sand, 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, moderately slowly permeable soils on terraces along streams. These soils formed in silty alluvium. Slopes range from 0 to 2 percent.

Reading soils are similar to Muir soils and are commonly adjacent to Chase, Kennebec, Tully, and Wabash soils. Muir soils do not have an argillic horizon and have a mollic epipedon that is more than 20 inches thick. They are on terraces along the major rivers. Chase and Tully soils have more clay in the subsoil than the Reading soils. Chase soils are on the lower terraces, and Tully soils are on foot slopes. Kennebec and Wabash soils are on flood plains. Kennebec soils do not have an argillic horizon. The very poorly drained Wabash soils are more clayey throughout than the Reading soils.

Typical pedon of Reading silty clay loam, 1,600 feet west and 2,100 feet south to the northeast corner of sec. 33, T. 6 S., R. 8 E.

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

A—6 to 20 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate medium granular structure; friable, slightly hard; common fine roots; slightly acid; gradual smooth boundary.

Bt1—20 to 30 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; moderate fine subangular blocky structure; friable, hard; few fine roots; thin discontinuous clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt2—30 to 38 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable, hard; few fine roots; thin discontinuous clay films on faces of peds; slightly acid; clear smooth boundary.

BC—38 to 53 inches; dark brown (10YR 4/3) silty clay loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; friable, hard; very few fine roots; neutral; gradual smooth boundary.

C—53 to 60 inches; dark brown (10YR 4/3) silty clay loam, brown (10YR 5/3) dry; massive; firm, hard; neutral.

The solum ranges from 40 to 60 inches in thickness. It is medium acid to neutral. The mollic epipedon is more than 24 inches thick.

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

Sarpy soils are commonly adjacent to Eudora, Haynie, and Paxico soils. The well drained Eudora soils are on stream terraces. The moderately well drained Haynie soils and the somewhat poorly drained Paxico soils are less sandy throughout than the Sarpy soils. They are in positions on the landscape similar to those of the Sarpy soils.

Typical pedon of Sarpy sand, frequently flooded, 800 feet west and 1,400 feet south of the northeast corner of sec. 28, T. 10 S., R. 12 E.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) sand, brown (10YR 5/3) dry; single grained; loose; common fine roots; neutral; clear smooth boundary.

C1—6 to 25 inches; brown (10YR 5/3) sand, very pale brown (10YR 7/3) dry; single grained; loose; few fine roots; neutral; gradual smooth boundary.

C2—25 to 42 inches; pale brown (10YR 6/3) sand, very pale brown (10YR 7/3) dry; single grained; loose; neutral; gradual smooth boundary.

C3—42 to 60 inches; brown (10YR 5/3) sand, very pale brown (10YR 7/3) dry; single grained; loose; strong effervescence; moderately alkaline.

The soils are neutral to moderately alkaline throughout. Some pedons have free carbonates in the control section.

The A horizon has hue of 10YR, value of 3 to 5 (4 to 6 dry), and chroma of 1 to 3. It is sand, loamy sand, or 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. In some pedons it has mottles with chroma of 3 or higher within a depth of 40 inches and mottles with chroma of 2 below a depth of 40 inches. This horizon is loamy fine sand, fine sand, or sand.

Sharpsburg Series

The Sharpsburg series consists of deep, moderately well drained, moderately slowly permeable soils on uplands. These soils formed in loess. Slopes range from 1 to 4 percent.

Sharpsburg soils are similar to Elmont and Gymer soils and are commonly adjacent to Morrill, Ortello, and Wymore Variant soils. The well drained Elmont soils are on side slopes. Gymer soils have a reddish brown subsoil. They are on foot slopes. Morrill and Ortello soils have more sand throughout than the Sharpsburg soils. They are on side slopes and foot slopes below the Sharpsburg soils. Wymore Variant soils have more clay in the subsoil than the Sharpsburg soils. They are in positions on the landscape similar to those of the Sharpsburg soils.

Typical pedon of Sharpsburg silt loam, 1 to 4 percent slopes, 900 feet north and 100 feet west of the southeast corner of sec. 3, T. 10 S., R. 8 E.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable, hard; many fine roots; slightly acid; clear smooth boundary.

A—7 to 12 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark brown (10YR 3/3) dry; moderate medium granular structure; friable, hard; many fine roots; slightly acid; gradual smooth boundary.

BA—12 to 18 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 4/3) dry; moderate fine subangular blocky structure; firm, hard; few thin discontinuous clay films; waxy coatings on faces of peds; many fine roots; slightly acid; gradual smooth boundary.

Bt1—18 to 24 inches; dark brown (10YR 4/3) silty clay loam, brown (10YR 5/3) dry; moderate medium subangular blocky structure; firm, hard; thin discontinuous clay films on faces of peds; common fine roots; slightly acid; gradual smooth boundary.

Bt2—24 to 34 inches; brown (10YR 4/3) silty clay loam, light yellowish brown (10YR 6/4) dry; few fine faint grayish brown (10YR 5/2) mottles; weak fine prismatic structure parting to moderate medium subangular blocky; firm, hard; thin discontinuous clay films on faces of peds; common fine roots; slightly acid; gradual smooth boundary.

BC—34 to 44 inches; brown (10YR 4/3) silty clay loam, light yellowish brown (10YR 6/4) dry; few fine faint grayish brown (10YR 5/2) and few fine distinct yellowish brown (10YR 5/6) mottles; weak fine prismatic structure parting to weak medium subangular blocky; firm, hard; few thin discontinuous clay films; few fine roots; slightly acid; gradual smooth boundary.

C—44 to 60 inches; brown (10YR 4/3) silty clay loam, light yellowish brown (10YR 6/4) dry; few fine distinct yellowish brown (10YR 5/6) mottles; massive; friable, hard; thin clay films in root channels; few fine roots; slightly acid.

The solum ranges from 36 to 50 inches in thickness. It is slightly acid to strongly acid.

The A horizon has hue of 10YR, value of 2 or 3 (3 to 5 dry), and chroma of 2 or 3. It is silt loam or silty clay loam. The Bt horizon has hue of 10YR or 7.5YR, value of 3 or 4 (4 or 5 dry), and chroma of 3 or 4. In some pedons it is not mottled in the lower part. It typically is silty clay loam, but in some pedons it is silty clay. The C horizon has hue of 10YR or 7.5YR, value of 4 to 6 (5 to 7 dry), and chroma of 2 to 6. It typically is silty clay loam, but in some pedons it is silt loam.

Sogn Series

The Sogn series consists of shallow, somewhat excessively drained, moderately permeable soils on uplands. These soils formed in limestone residuum (fig. 14). Slopes range from 5 to 20 percent.

Sogn soils are commonly adjacent to Benfield, Clime, and Tully soils. The moderately deep Benfield soils have an argillic horizon. They are higher on the landscape than the Sogn soils. The moderately deep Clime soils are calcareous and fine textured. They are on side slopes. The deep Tully soils have an argillic horizon. They are on foot slopes.

Typical pedon of Sogn silty clay loam, in an area of Clime-Sogn silty clay loams, 5 to 20 percent slopes, 1,300 feet west and 2,390 feet south of the northeast corner of sec. 30, T. 7 S., R. 10 E.

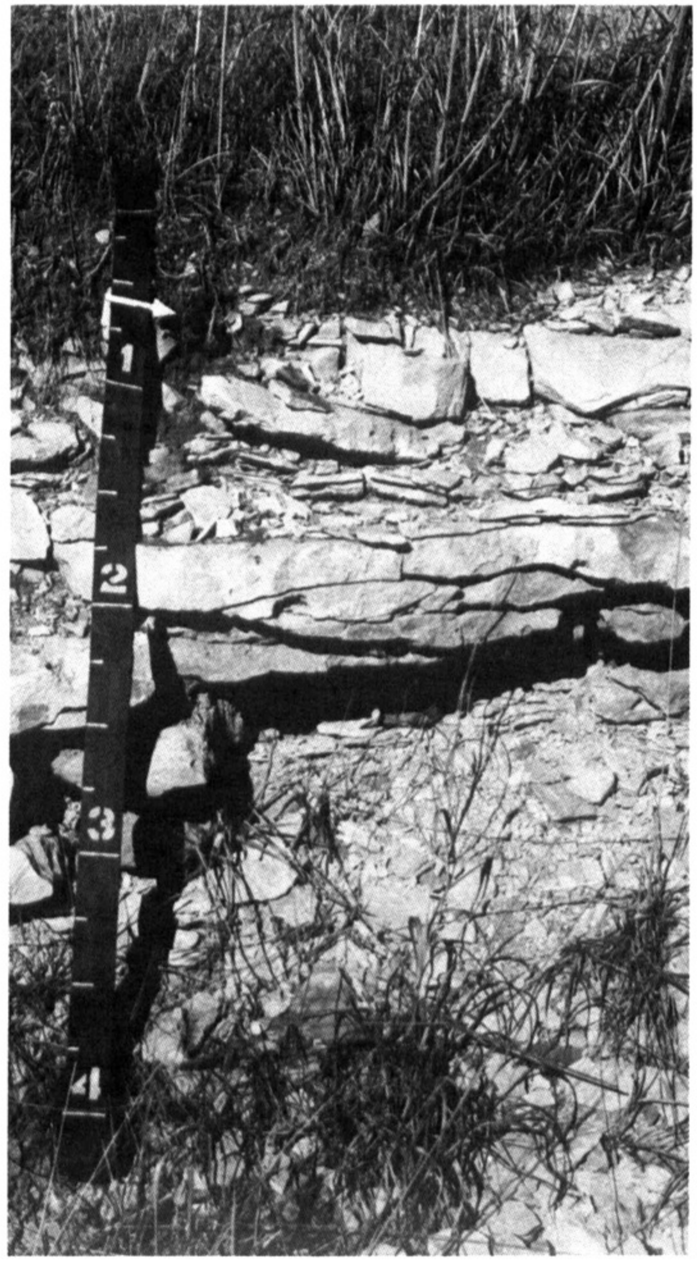


Figure 14.—Profile of Sogn soils, which are shallow over limestone bedrock. Depth is marked in feet.

A—0 to 14 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; moderate fine granular structure; friable, hard; many fine and very fine roots; few limestone fragments less than 0.5 inch in diameter; moderately alkaline; abrupt wavy boundary.

R—14 inches; unweathered limestone bedrock.

The thickness of the solum, the thickness of the mollic epipedon, and the depth to limestone range from 4 to 20 inches. The A horizon has hue of 7.5YR to 2.5Y, value of 2 or 3 (3 to 5 dry), and chroma of 1 to 3. It is silty clay loam or silt loam. It ranges from slightly acid to moderately alkaline.

Thurman Series

The Thurman series consists of deep, somewhat excessively drained, rapidly permeable soils on uplands. These soils formed in sandy eolian material. Slopes range from 3 to 8 percent.

Thurman soils are similar to Ortello soils and are commonly adjacent to Morrill, Ortello, and Wann soils. Ortello soils are less sandy throughout than the Thurman soils. They commonly are on ridgetops and the upper side slopes. Morrill soils are more clayey throughout than the Thurman soils. Also, they are higher on the landscape. The poorly drained Wann soils are on flood plains.

Typical pedon of Thurman loamy fine sand, 3 to 8 percent slopes, 900 feet west and 500 feet south of the northeast corner of sec. 11, T. 10 S., R. 9 E.

A1—0 to 10 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable, soft; neutral; gradual smooth boundary.

A2—10 to 17 inches; dark brown (10YR 3/3) loamy fine sand, brown (10YR 5/3) dry; weak fine granular structure; very friable, soft; neutral; gradual smooth boundary.

C1—17 to 36 inches; brown (10YR 4/3) loamy fine sand, pale brown (10YR 6/3) dry; single grained; loose; neutral; thin discontinuous strata of dark yellowish brown (10YR 4/4) sandy loam; neutral; diffuse smooth boundary.

C2—36 to 60 inches; yellowish brown (10YR 5/4) loamy fine sand, light yellowish brown (10YR 6/4) dry; single grained; loose; discontinuous strata of dark reddish brown (5YR 3/4) sandy loam; neutral.

The thickness of the solum ranges from 14 to 30 inches. The depth to free carbonates typically is more than 5 feet. Reaction is slightly acid or neutral throughout the profile.

The A horizon has hue of 10YR, value of 2 or 3 (3 to 5 dry), and chroma of 1 to 3. It typically is loamy fine sand, but the range includes loamy sand and fine sandy loam. The C horizon has hue of 10YR, value of 4 or 5 (5 to 7 dry), and chroma of 2 to 4. It is loamy fine sand, fine sand, or loamy sand and has thin strata of sandy loam.

Tully Series

The Tully series consists of deep, well drained, slowly permeable soils on uplands. These soils formed in colluvium and local alluvium. Slopes range from 3 to 7 percent.

Tully soils are similar to Pawnee and Wymore soils and are commonly adjacent to Clime, Kennebec, Sogn, and Tuttle soils. Pawnee soils formed in glacial till. Wymore soils have a mollic epipedon that is less than 20 inches thick. They formed in loess. The moderately deep Clime soils are on side slopes. Kennebec soils do not have an argillic horizon. They are on flood plains along streams. The shallow Sogn soils are on narrow ridgetops. The calcareous Tuttle soils are on the steeper slopes above the Tully soils.

Typical pedon of Tully silty clay loam, 3 to 7 percent slopes, 2,195 feet east and 1,780 feet north of the southwest corner of sec. 2, T. 8 S., R. 8 E.

A—0 to 13 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine granular structure; friable, slightly hard; many fine and very fine roots; few fine chert fragments; medium acid; gradual smooth boundary.

BA—13 to 20 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark brown (7.5YR 4/2) dry; moderate fine granular and subangular blocky structure; firm, hard; few fine chert fragments; many fine and very fine roots; medium acid; gradual smooth boundary.

Bt1—20 to 29 inches; very dark grayish brown (10YR 3/2) silty clay, brown (7.5YR 4/2) dry; few fine faint yellowish brown (10YR 5/4) mottles; moderate medium blocky structure; firm, very hard; few fine chert fragments; common fine and very fine roots; thin discontinuous clay films on faces of peds; medium acid; gradual smooth boundary.

Bt2—29 to 42 inches; dark brown (7.5YR 4/2) silty clay, brown (7.5YR 5/2) dry; few fine faint yellowish brown (10YR 5/4) mottles; weak fine and medium blocky structure; firm, very hard; few fine chert fragments; common fine and very fine roots; thin discontinuous clay films on faces of peds; medium acid; gradual smooth boundary.

BC—42 to 60 inches; dark brown (7.5YR 4/2) silty clay, brown (7.5YR 5/2) dry; few fine faint strong brown (7.5YR 5/6) mottles; weak fine blocky structure; firm, hard; common fine roots; few fine and medium chert fragments; neutral.

The thickness of the solum ranges from 36 to 60 inches. The mollic epipedon ranges from 20 to more than 40 inches in thickness. The depth to free carbonates ranges from 30 to more than 60 inches. The content of chert or limestone fragments as much as to 3 inches in diameter ranges from 0 to 20 percent 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 silty clay loam or silty clay. It ranges from medium acid to neutral.

The Bt horizon has hue of 10YR or 7.5YR, value of 3 to 5 (4 to 6 dry), and chroma of 2 to 4. In some pedons it has mottles with chroma of more than 2. This horizon is silty clay loam, silty clay, or the cherty analogs of these textures. It has a clay content of 35 to 55 percent. It ranges from medium acid to neutral in the upper part and from slightly acid to moderately alkaline in the lower part.

The C horizon, if it occurs, has hue of 5YR to 10YR, value of 3 to 5 (4 to 6 dry), and chroma of 2 to 6. It is silty clay, clay, silty clay loam, or the cherty analogs of these textures. In some pedons it has thin lenses of gravel. It ranges from neutral to moderately alkaline.

Tuttle Series

The Tuttle series consists of deep, somewhat excessively drained, slowly permeable soils on uplands. These soils formed in colluvium over material weathered from calcareous shale and limestone. Slopes range from 20 to 40 percent.

Tuttle soils are commonly adjacent to Benfield, Clime, Sogn, and Tully soils. The moderately deep Benfield soils and the deep Tully soils have an argillic horizon. Benfield soils are on ridgetops, and Tully soils are on foot slopes. The moderately deep Clime soils are more clayey throughout than the Tuttle soils. They are in positions on the landscape similar to those of the Tuttle soils. The shallow Sogn soils are on ridgetops.

Typical pedon of Tuttle channery silty clay loam, 20 to 40 percent slopes, stony, 1,500 feet north and 400 feet east of the southwest corner of sec. 16, T. 8 S., R. 7 E.

A—0 to 15 inches; very dark brown (10YR 2/2) channery silty clay loam, very dark grayish brown (10YR 3/2) dry; moderate fine granular structure; friable, slightly hard; many fine and medium roots; few chert fragments less than 2 inches in diameter; about 20 percent limestone channers 0.25 inch to 24 inches long; strong effervescence; moderately alkaline; abrupt smooth boundary.

Bw1—15 to 24 inches; very dark grayish brown (10YR 3/2) channery silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine blocky structure; friable, slightly hard; many fine and medium roots; about 25 percent limestone channers 0.25 inch to 24 inches long; few gravel-size fragments; strong effervescence; moderately alkaline; abrupt smooth boundary.

2Bw2—24 to 36 inches; dark reddish gray (5YR 4/2) channery silty clay loam, brown (7.5YR 5/2) dry; moderate fine subangular blocky structure; friable, slightly hard; many fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

2Bw3—36 to 46 inches; brown (7.5YR 4/4) silty clay loam, light brown (7.5YR 6/4) dry; weak fine subangular blocky structure; friable, slightly hard; common fine roots; about 10 percent gravel to stone-size limestone channers, flags, and pebbles; strong effervescence; moderately alkaline; clear smooth boundary.

2Cr—46 to 60 inches; soft, white, calcareous silty shale.

The thickness of the solum and the depth to shale range from 40 to 54 inches. The mollic epipedon ranges from 12 to 27 inches in thickness. Free carbonates generally are at the surface.

The A horizon has hue of 10YR, value of 2 or 3 (moist and dry), and chroma of 1 to 3. It is silty clay loam, clay loam, or the gravelly or channery analogs of these textures. It commonly is moderately alkaline, but in some pedons it is neutral. The content of limestone channers less than 3 inches in size ranges from 0 to 30 percent in this horizon, and the content of limestone fragments more than 3 inches in size ranges from 5 to 30 percent.

The B 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 gravelly or channery analogs of these textures. The content of limestone fragments less than 3 inches in size ranges from 0 to 40 percent in this horizon, and the content of limestone fragments more than 3 inches in size ranges from 0 to 40 percent.

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

Wabash Series

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

Wabash soils are similar to Zook soils and are commonly adjacent to Chase, Kennebec, and Reading soils. The poorly drained Zook soils are in the slightly higher landscape positions. The somewhat poorly drained Chase soils and the well drained Reading soils are on stream terraces. The moderately well drained Kennebec soils are near stream channels. They are less clayey throughout than the Wabash soils.

Typical pedon of Wabash silty clay, occasionally flooded, 400 feet west and 1,400 feet south of the northeast corner of sec. 17, T. 8 S., R. 11 E.

Ap—0 to 5 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; firm, very hard; many fine roots; neutral; abrupt smooth boundary.

A1—5 to 7 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; strong medium blocky structure; very firm, very hard; common fine roots; neutral; abrupt smooth boundary.

A2—7 to 18 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; very firm, very hard; few fine roots; neutral; clear smooth boundary.

Bg1—18 to 24 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; few fine distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; very firm, very hard; few slickensides; few fine roots; few fine black and very dark brown concretions; neutral; gradual smooth boundary.

Bg2—24 to 32 inches; dark gray (10YR 4/1) silty clay, gray (10YR 5/1) dry; few fine distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; very firm, very hard; few slickensides; few fine roots; few fine black and very dark brown concretions; mildly alkaline; gradual smooth boundary.

Bg3—32 to 60 inches; dark grayish brown (10YR 4/2) silty clay, gray (10YR 5/1) dry; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; very firm, very hard; few slickensides; few fine roots; few black and very dark brown concretions; mildly alkaline.

The solum ranges from 40 to more than 60 inches in thickness. It is 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, and chroma of 2 or less. It is silty clay or silty clay loam. The B horizon has hue of 10YR to 5Y, value of 2 to 5, and chroma of 2 or less. Mottles with high chroma commonly are in the upper part of the solum, and mottles with low chroma are throughout the solum. Some pedons have a C horizon below a depth of 40 inches.

Wamego Series

The Wamego series consists of moderately deep, well drained, slowly permeable soils on uplands. These soils generally formed in silty shale residuum. Slopes range from 3 to 20 percent.

Wamego soils are commonly adjacent to the Clime, Elmont, Pawnee, and Wymore soils. The calcareous Clime soils and the deep, moderately well drained Pawnee and Wymore soils are higher on the landscape than the Wamego soils. Clime soils do not have an argillic horizon. The deep, moderately slowly permeable Elmont soils are lower on the landscape than the Wamego soils.

Typical pedon at Wamego silt loam, 7 to 20 percent slopes, 1,100 feet east and 400 feet south of the northwest corner of sec. 5, T. 8 S., R. 11 E.

A—0 to 6 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak very fine granular structure; friable, slightly acid; clear smooth boundary.

AB—6 to 10 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable, slightly hard; many fine roots; slightly acid; clear smooth boundary.

Bt1—10 to 17 inches; dark brown (10YR 4/3) silty clay loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; friable, hard; some very dark grayish brown (10YR 3/2) faces of peds; few fine sandstone fragments; common fine roots; thin discontinuous clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt2—17 to 27 inches; yellowish brown (10YR 5/4) silty clay loam, light yellowish brown (10YR 6/4) dry; weak medium subangular blocky structure; friable, hard; some dark brown (10YR 4/3) faces of peds; common fine sandstone and shale fragments; few fine roots; thin discontinuous clay films on faces of peds; slightly acid; clear smooth boundary.

Cr—27 to 48 inches; pale brown and yellowish brown shale.

The thickness of the solum and the depth to shale bedrock range from 20 to 40 inches. The mollic epipedon is 7 to 18 inches thick. The content of shale and sandstone fragments 2 millimeters to 3 inches in diameter ranges from 0 to 15 percent throughout the profile. 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 silt loam, silty clay loam, or 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. It 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.

Wann Series

The Wann series consists of deep, somewhat poorly drained, moderately rapidly permeable soils on flood plains. These soils formed in stratified alluvium. Slopes range from 0 to 2 percent.

Wann soils are commonly adjacent to Morrill, Ortello, and Thurman soils. Morrill soils have an argillic horizon. They are on the upper side slopes. The well drained Ortello soils and the somewhat excessively drained Thurman soils are on side slopes.

Typical pedon of Wann fine sandy loam, channeled, 500 feet north and 50 feet west of the southeast corner of sec. 34, T. 9 S., R. 9 E.

A—0 to 11 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable, slightly hard; many fine roots; neutral; clear smooth boundary.

AC—11 to 20 inches; dark brown (10YR 4/3) fine sandy loam, yellowish brown (10YR 5/4) dry; few fine faint dark yellowish brown (10YR 4/4) mottles; weak coarse subangular blocky structure; friable, slightly hard; common fine roots; neutral; gradual smooth boundary.

Cg1—20 to 36 inches; dark grayish brown (10YR 4/2) sandy loam, grayish brown (10YR 5/2) dry; few fine faint yellowish brown (10YR 5/6) mottles; massive; friable, slightly hard; few fine roots; mildly alkaline; gradual smooth boundary.

Cg2—36 to 45 inches; dark grayish brown (10YR 4/2) and brown (10YR 5/3) sandy loam, grayish brown (10YR 5/2) and pale brown (10YR 6/3) dry; many medium distinct yellowish brown (10YR 5/6) mottles; massive; very friable, slightly hard; few fine roots; mildly alkaline; gradual smooth boundary.

Cg3—45 to 60 inches; brown (10YR 5/3) and dark grayish brown (10YR 4/2) fine sandy loam, pale brown (10YR 6/3) and grayish brown (10YR 5/2) dry; many medium distinct yellowish brown (10YR 5/6) mottles; massive; very friable, slightly hard; mildly alkaline.

The thickness of the mollic epipedon ranges from 8 to 20 inches. Mottles typically are in the C horizon but can occur in any part of the profile beneath the A horizon.

The A horizon has hue of 10YR, value of 2 or 3 (4 or 5 dry), and chroma of 1 or 2. It is fine sandy loam, loam, or sandy loam. It ranges from neutral to moderately alkaline. Some pedons have an AC horizon, which is intermediate in color and texture between the A horizon and the C horizon. The C horizon has hue of 10YR or 2.5Y and value of 4 to 6 (5 to 7 dry). It has chroma of 2 (moist and dry) in the upper part and chroma of 1 to 4 in the lower part. It is fine sandy loam or sandy loam. Thin strata of loam or loamy sand are common in the control section. In some pedons sand, gravelly sand, or loam is below a depth of 40 inches.

Wymore Series

The Wymore series consists of deep, moderately well drained, slowly permeable soils on uplands. These soils formed in loess. Slopes range from 0 to 7 percent.

Wymore soils are similar to Pawnee and Tully soils and are commonly adjacent to Benfield, Morrill, Ortello, and Pawnee soils. Pawnee, Morrill, and Ortello soils are more sandy throughout the solum than the Wymore soils. Also, they are lower on the landscape. Tully soils have a mollic epipedon that is more than 20 inches thick. They are on foot slopes. The moderately deep Benfield soils generally are lower on the landscape than the Wymore soils.

Typical pedon of Wymore silty clay loam, 1 to 4 percent slopes, 1,500 feet east and 1,100 feet north of the southwest corner of sec. 11, T. 7 S., R. 8 E.

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

BA—6 to 10 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; moderate fine blocky structure; firm, hard; common fine roots; medium acid; gradual smooth boundary.

Bt1—10 to 17 inches; very dark brown (10YR 2/2) silty clay, very dark grayish brown (10YR 3/2) dry; few fine faint dark grayish brown (10YR 4/2) mottles; moderate fine and medium blocky structure; very firm, very hard; few fine roots; thin discontinuous clay films on faces of peds; medium acid; gradual smooth boundary.

Bt2—17 to 26 inches; dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) silty clay, grayish brown (10YR 5/2) and dark grayish brown (10YR 4/2) dry; few fine distinct yellowish brown (10YR 5/6) and very dark gray (10YR 3/1) mottles; moderate fine blocky structure; very firm, very hard; thin discontinuous clay films on faces of peds; few fine roots; slightly acid; gradual smooth boundary.

Bt3—26 to 35 inches; brown (10YR 4/3) silty clay, pale brown (10YR 6/3) dry; common fine distinct yellowish brown (10YR 5/6) and very dark gray (10YR 3/1) mottles; weak medium blocky structure; very firm, very hard; thin discontinuous clay films on faces of peds; very few fine roots; slightly acid; gradual smooth boundary.

Bt4—35 to 39 inches; brown (10YR 5/3) silty clay loam, pale brown (10YR 6/3) dry; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium and coarse blocky structure; firm, hard; very few fine roots; thin discontinuous clay films on faces of peds; few fine black stains; slightly acid; gradual smooth boundary.

BC—39 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam, light brownish gray (2.5Y 6/2) dry; common fine and medium yellowish brown (10YR 5/6) mottles; weak coarse blocky structure; firm, hard; very few fine roots; few fine black stains and rounded concretions; neutral.

The solum ranges from 33 to 60 inches in thickness. It is medium acid to neutral. The mollic epipedon ranges from 10 to 24 inches in thickness.

The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 1 or 2. It is silty clay loam or silty clay. 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.

Wymore Variant

The Wymore Variant consists of deep, moderately well drained, slowly permeable soils on uplands. These soils formed in loamy eolian material over loess. Slopes range from 1 to 3 percent.

Wymore Variant soils are commonly adjacent to Morrill, Ortello, and Sharpsburg soils. Morrill and Ortello soils are more sandy throughout the solum than the Wymore soils. Also, they are lower on the landscape. The moderately slowly permeable Sharpsburg soils have a silty A horizon. They are in positions on the landscape similar to those of the Wymore Variant soils.

Typical pedon of Wymore Variant fine sandy loam, 1 to 3 percent slopes, 2,100 feet east and 1,200 feet north of the southwest corner of sec. 10, T. 10 S., R. 9 E.

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

A—6 to 12 inches; very dark brown (10YR 2/2) fine sandy loam, very dark grayish brown (10YR 3/2) dry; moderate fine and medium granular structure; slightly hard, friable; common fine roots; neutral; gradual smooth boundary.

AB—12 to 17 inches; dark brown (7.5YR 3/2) fine sandy loam, dark brown (10YR 3/3) and dark yellowish brown (10YR 4/4) dry; moderate fine subangular blocky structure; slightly hard, friable; few fine roots; slightly acid; abrupt smooth boundary.

2Bt1—17 to 28 inches; dark grayish brown (10YR 4/2) silty clay, grayish brown (10YR 5/2) dry; common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; very hard, very firm; slightly acid; thin discontinuous clay films on faces of peds; gradual smooth boundary.

2Bt2—28 to 42 inches; brown (10YR 5/3) silty clay, pale brown (10YR 6/3) and brown (10YR 5/3) dry; few fine distinct yellowish brown (10YR 5/6) mottles; weak fine and medium subangular blocky structure; very hard, very firm; thin discontinuous clay films on faces of peds; neutral; gradual smooth boundary.

3C—42 to 60 inches; brown (10YR 5/3) silty clay loam, pale brown (10YR 6/3) dry; few fine distinct yellowish brown (10YR 5/6) mottles; massive; hard, firm; neutral.

The solum ranges from 30 to 54 inches in thickness. It is medium acid to neutral. The thickness of the mollic epipedon ranges from 10 to 24 inches.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 (3 or 4 dry), and chroma of 1 to 3. It typically is fine sandy loam, but in some pedons it is very fine sandy loam. The 2Bt horizon has hue of 10YR, value of 3 to 5 (4 to 6 dry), and chroma of 2 or 3. In some pedons it is not mottled. In other pedons, however, it has mottles with hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. The 3C horizon has hue of 10YR, value of 4 or 5 (5 or 6 dry), and chroma of 2 to 4.

Zook Series

The Zook series consists of deep, poorly drained, slowly permeable soils on terraces or flood plains along the major streams. These soils formed in clayey alluvium. Slopes are 0 to 1 percent.

Zook soils are similar to Chase and Wabash soils and are commonly adjacent to Eudora and Muir soils. The somewhat poorly drained Chase soils are on stream terraces. They have an argillic horizon. The very poorly drained Wabash soils are in positions on the landscape similar to those of the Zook soils. The well drained Eudora and Muir soils are nearer to the river channels than the Zook soils. Also, they are less clayey throughout.

Typical pedon of Zook silty clay loam, occasionally flooded, 2,490 feet north and 300 feet west of the center of sec. 19, T. 9 S., R. 11 E.

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

A1—8 to 20 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; firm, hard; common fine roots; neutral; clear smooth boundary.

A2—20 to 31 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate fine blocky structure; firm, very hard; common fine roots; neutral; gradual smooth boundary.

Bg1—31 to 40 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; firm, hard; common fine roots; neutral; gradual smooth boundary.

Bg2—40 to 53 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; few fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; firm, extremely hard; few fine roots; neutral; diffuse smooth boundary.

Cg—53 to 60 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; few fine distinct yellowish brown (10YR 5/6) mottles; massive; very firm, extremely hard; neutral.

The solum ranges from 36 to 60 inches in thickness. It typically is silty clay loam or silty clay. It has a clay content of 32 to 45 percent. It ranges from medium acid to mildly alkaline. The mollic epipedon ranges from 36 to 50 inches in thickness.

The A horizon has hue of 10YR or is neutral in hue. It has value of 2 or 3 (3 or 4 dry) and chroma of 0 to 2. The Bg and Cg horizons have hue of 10YR to 5Y, value of 2 to 5 (moist and dry), and chroma of 1.

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 among five factors of soil formation: 1) the physical and mineralogical composition of the parent material, 2) the climate under which the soil material accumulated and has existed since accumulation, 3) the plant and animal life on and in the soil, 4) the relief, and 5) 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 Pottawatomie County formed in alluvium; glacial till and outwash; loess; shale, sandstone, and limestone residuum; colluvium; and sandy eolian deposits.

Pennsylvanian rocks are the oldest rocks that crop out 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 county from Wamego to the northeast corner. Elmont and Wamego soils formed in material weathered from these rocks.

Permian rocks crop out extensively east and west of the Nemaha range. They include cherty limestone, limestone, and shale. Florence soils formed in cherty limestone residuum, Sogn soils in limestone residuum, and Benfield and Clime soils in shale residuum.

Most of the county is covered by till. The thickness of loess over the till varies. 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 silt and clay particles. It is sometimes carried hundreds of miles from its source. Loess deposits of varying thickness cover most of the county. Those on unstable landscapes generally have been removed by geologic erosion. Wymore soils formed in Peorian loess deposited during the Pleistocene Epoch. Gymer, Monona, and Sharpsburg soils formed in loess deposits of undetermined age.

Ortello and Thurman soils formed mainly in sandy eolian deposits near St. George. Tully and Tuttle soils formed in silty colluvium.

Alluvium is sediment deposited by floodwater in stream and river valleys. It is a heterogenous 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 alluvial material and on drainage characteristics. Chase, Eudora, Haynie, Kennebec, Kimo, Muir, Paxico, Reading, Sarpy, Wabash, Wann, and Zook 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.

The climate of Pottawatomie 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 and thus in a granular structure that 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 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 greatly affected soil formation in Pottawatomie 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 transitional part in many areas 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 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 rapid on these strongly 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, erosion is less extensive, and more water percolates through the profile. In areas where relief is gentle, the soils generally receive runoff from higher lying areas.

Time

The length of time that the soil material has been subject to weathering and to 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 in the soils in Pottawatomie County varies. The soils on bottom land, such as Kennebec soils, are subject to stream overflow. They receive new sediments with each flood. 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 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—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedding 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.

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.

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.

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.

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.

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.

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.

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 drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the sorted and unsorted material deposited by streams flowing from glaciers.

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 up to 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.

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.

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.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

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-size particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the 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.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multipled 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 of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

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.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

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 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 Wamego, 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----	39.2	18.0	28.6	67	-10	0.76	0.20	1.33	2	5.6
February---	46.0	23.7	34.9	74	-5	1.01	.36	1.68	2	5.0
March------	54.8	31.2	43.0	84	4	2.04	.60	2.60	4	3.9
April------	68.8	43.6	56.2	91	23	2.80	1.62	3.99	5	.5
May--------	77.9	54.2	66.1	95	34	4.23	2.81	5.21	7	.0
June-------	86.3	63.5	74.9	102	45	5.23	2.41	6.64	7	.0
July-------	91.4	67.7	79.6	107	51	4.61	1.63	6.56	6	.0
August-----	90.4	66.2	78.3	105	50	3.05	1.45	5.16	5	.0
September--	82.0	57.0	69.5	100	37	3.86	1.35	5.87	6	.0
October----	71.5	46.3	58.9	91	25	2.87	1.05	4.65	5	.0
November---	55.3	32.7	44.0	78	7	1.50	.17	2.58	3	1.5
December---	43.2	23.0	33.1	69	-5	1.12	.44	1.91	3	5.0
Year-----	67.2	43.9	55.6	108	-11	33.08	22.07	41.06	55	21.5

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Minimum temperature		
	24^{o} F or lower	28^{o} F or lower	32^{o} F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 10	Apr. 24	May 9
2 years in 10 later than--	Apr. 5	Apr. 19	May 4
5 years in 10 later than--	Mar. 27	Apr. 9	Apr. 24
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 22	Oct. 12	Oct. 2
2 years in 10 earlier than--	Oct. 26	Oct. 17	Oct. 6
5 years in 10 earlier than--	Nov. 5	Oct. 26	Oct. 16

TABLE 3.--GROWING SEASON

Probability	Daily minimum temperature during growing season		
	Higher than 24^{o} F	Higher than 28^{o} F	Higher than 32^{o} F
	Days	Days	Days
9 years in 10	202	180	152
8 years in 10	209	187	160
5 years in 10	223	200	175
2 years in 10	233	213	190
1 year in 10	240	219	198

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Bd	Benfield silty clay loam, 2 to 5 percent slopes	22,200	4.0
Bf	Benfield-Florence complex, 3 to 15 percent slopes	45,200	8.2
Ce	Chase silty clay loam	10,800	2.0
Cm	Clime silty clay loam, 20 to 40 percent slopes, stony	17,400	3.2
Cs	Clime-Sogn silty clay loams, 5 to 20 percent slopes	108,106	19.6
Em	Elmont silty clay loam, 3 to 7 percent slopes	12,200	2.2
Eo	Elmont silty clay loam, 3 to 7 percent slopes, eroded	440	0.1
Eu	Eudora silt loam	4,460	0.8
Ex	Eudora-Kimo complex	1,680	0.3
Gm	Gymer silty clay loam, 3 to 8 percent slopes	650	0.1
Hn	Haynie very fine sandy loam, occasionally flooded	2,400	0.4
Hs	Haynie-Sarpy complex, occasionally flooded	2,900	0.5
Kc	Kennebec silt loam, channeled	7,940	1.4
Kf	Kennebec silt loam, occasionally flooded	32,610	5.9
Km	Kimo silty clay	700	0.1
Mm	Monona silt loam, 5 to 10 percent slopes	160	*
Mo	Morrill loam, 3 to 7 percent slopes	12,600	2.3
Mr	Morrill clay loam, 3 to 7 percent slopes, eroded	500	0.1
Mt	Morrill loam, 5 to 20 percent slopes, stony	3,000	0.5
Mu	Muir silt loam	6,400	1.2
Op	Ortello fine sandy loam, 3 to 7 percent slopes	3,400	0.6
Ot	Ortello fine sandy loam, 7 to 12 percent slopes	1,600	0.3
Pe	Pawnee clay loam, 1 to 3 percent slopes	24,500	4.4
Pn	Pawnee clay loam, 3 to 6 percent slopes	41,900	7.6
Po	Pawnee clay, 3 to 6 percent slopes, eroded	2,300	0.4
Ps	Paxico silt loam, frequently flooded	6,900	1.3
Pt	Pits, quarries	900	0.2
Re	Reading silty clay loam	10,620	1.9
Sf	Sarpy sand, frequently flooded	700	0.1
Sg	Sharpsburg silt loam, 1 to 4 percent slopes	2,000	0.4
Th	Thurman loamy fine sand, 3 to 8 percent slopes	3,200	0.6
Tu	Tully silty clay loam, 3 to 7 percent slopes	62,400	11.3
Tx	Tully silty clay, 3 to 7 percent slopes, eroded	4,400	0.8
Tz	Tuttle channery silty clay loam, 20 to 40 percent slopes, stony	8,200	1.5
Wb	Wabash silty clay, occasionally flooded	8,000	1.5
Wd	Wamego silt loam, 3 to 7 percent slopes	6,900	1.3
We	Wamego silt loam, 7 to 20 percent slopes	18,100	3.3
Wg	Wann fine sandy loam, channeled	1,200	0.2
Wk	Wymore silty clay loam, 0 to 1 percent slopes	900	0.2
Wm	Wymore silty clay loam, 1 to 4 percent slopes	31,500	5.7
Wn	Wymore silty clay loam, 4 to 7 percent slopes	3,600	0.7
Ws	Wymore Variant fine sandy loam, 1 to 3 percent slopes	800	0.1
Zo	Zook silty clay loam, occasionally flooded	4,100	0.7
	Water	10,900	2.0
	Total	551,366	100.0

* Less than 0.1 percent.

TABLE 5.--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	Alfalfa hay	Smooth bromegrass
		Bu	Bu	Bu	Bu	Tons	AUM*
Bd-------------- Benfield	IIIe	32	55	---	30	3.5	5.0
Bf-------------- Benfield-Florence	VIe	---	---	---	---	---	---
Ce-------------- Chase	IIw	43	85	82	36	4.5	8.0
Cm-------------- Clime	VIIe	---	---	---	---	---	---
Cs-------------- Clime-Sogn	VIe	---	---	---	---	---	---
Em-------------- Elmont	IIIe	38	84	80	32	3.6	6.5
Eo-------------- Elmont	IIIe	34	78	75	30	3.4	5.5
Eu-------------- Eudora	I	46	89	90	45	5.0	7.5
Ex-------------- Eudora-Kimo	IIw	47	97	85	43	4.9	7.0
Gm-------------- Gymer	IIIe	41	84	74	35	3.6	6.1
Hn-------------- Haynie	IIw	44	85	90	42	4.5	5.7
Hs-------------- Haynie-Sarpy	IIIw	35	75	---	---	4.0	4.5
Kc-------------- Kennebec	Vw	---	---	---	---	---	5.5
Kf-------------- Kennebec	IIw	45	85	100	54	4.5	7.1
Km-------------- Kimo	IIw	40	90	80	38	4.5	5.5
Mm-------------- Monona	IIIe	28	56	85	46	3.6	5.4
Mo-------------- Morrill	IIIe	38	85	80	32	3.6	6.5
Mr-------------- Morrill	IIIe	35	80	75	30	3.4	6.0
Mt-------------- Morrill	VIe	---	---	---	---	3.4	6.0

See footnotes at end of table.

TABLE 5.--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	Alfalfa hay	Smooth bromegrass
		Bu	Bu	Bu	Bu	Tons	AUM*
Mu-------------- Muir	I	45	85	90	38	5.0	6.2
Op-------------- Ortello	IIIe	30	58	60	26	2.8	2.7
Ot-------------- Ortello	IVe	26	56	52	21	2.3	2.6
Pe-------------- Pawnee	IIe	40	73	64	26	3.5	6.0
Pn-------------- Pawnee	IIIe	34	60	56	24	3.5	6.0
Po-------------- Pawnee	IVe	26	55	47	20	2.0	5.5
Ps-------------- Paxico	Vw	---	---	---	---	---	---
Pt**. Pits							
Re-------------- Reading	I	52	94	90	44	5.0	6.5
Sf-------------- Sarpy	IVs	20	40	---	---	2.0	1.8
Sg-------------- Sharpsburg	IIe	40	70	85	51	4.0	6.7
Th-------------- Thurman	IVe	25	50	55	20	1.3	2.0
Tu-------------- Tully	IIIe	37	65	52	25	3.3	5.5
Tx-------------- Tully	IVe	25	47	45	---	---	4.5
Tz-------------- Tuttle	VIIe	---	---	---	---	---	---
Wb-------------- Wabash	IIIw	35	65	70	32	3.5	5.0
Wd-------------- Wamego	IVe	30	65	60	22	2.5	6.0
We-------------- Wamego	VIe	---	---	---	---	---	5.0
Wg-------------- Wann	Vw	---	---	---	---	---	4.5
Wk-------------- Wymore	IIs	40	80	75	32	3.7	5.0
Wm-------------- Wymore	IIe	35	75	70	30	3.3	5.0

See footnotes at end of table.

TABLE 5.--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	Alfalfa hay	Smooth bromegrass
		Bu	Bu	Bu	Bu	Tons	AUM*
Wn-------------- Wymore	IIIe	33	70	55	25	3.0	4.5
Ws-------------- Wymore Variant	IIe	35	80	---	30	---	2.5
Zo-------------- Zook	IIw	34	70	95	38	3.8	4.0

* 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.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--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	Compo-sition
			Lb/acre		Pct
Bd: Benfield	Loamy Upland	Favorable	6,000	Big bluestem	35
		Normal	4,500	Little bluestem	20
		Unfavorable	3,000	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5
				Eastern gamagrass	5
Bf*:					
Benfield	Loamy Upland	Favorable	6,000	Big bluestem	35
		Normal	4,500	Little bluestem	20
		Unfavorable	3,000	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5
				Eastern gamagrass	5
Florence	Loamy Upland	Favorable	5,500	Big bluestem	40
		Normal	4,500	Little bluestem	20
		Unfavorable	3,500	Indiangrass	10
				Switchgrass	10
				Eastern gamagrass	5
				Tall dropseed	5
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: Clime	Limy Upland	Favorable	5,000	Big bluestem	30
		Normal	3,500	Little bluestem	20
		Unfavorable	2,500	Sideoats grama	10
				Indiangrass	10
				Switchgrass	5
				Jersey tea	5
				Leadplant	5
Cs*:					
Clime	Limy Upland	Favorable	5,000	Big bluestem	30
		Normal	3,500	Little bluestem	20
		Unfavorable	2,500	Sideoats grama	10
				Indiangrass	10
				Switchgrass	5
				Jersey tea	5
				Leadplant	5
Sogn	Shallow Limy	Favorable	3,500	Big bluestem	25
		Normal	2,500	Sideoats grama	15
		Unfavorable	1,500	Little bluestem	15
				Indiangrass	5
				Switchgrass	5
				Tall dropseed	5
				Blue grama	5
Em, Eo: Elmont	Loamy Upland	Favorable	6,000	Big bluestem	30
		Normal	5,000	Little bluestem	20
		Unfavorable	4,000	Indiangrass	15
				Switchgrass	5
				Tall dropseed	5

See footnote at end of table.

TABLE 6.--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
Eu: Eudora	Loamy Lowland	Favorable	9,000	Big bluestem	35
		Normal	7,000	Indiangrass	15
		Unfavorable	6,000	Prairie cordgrass	10
				Eastern gamagrass	10
				Switchgrass	5
Ex*:					
Eudora	Loamy Lowland	Favorable	9,000	Big bluestem	35
		Normal	7,000	Indiangrass	15
		Unfavorable	6,000	Prairie cordgrass	10
				Eastern gamagrass	10
				Switchgrass	5
Kimo	Clay Lowland	Favorable	9,000	Prairie cordgrass	40
		Normal	7,000	Big bluestem	15
		Unfavorable	5,000	Switchgrass	10
				Indiangrass	5
				Sedge	5
				Eastern gamagrass	5
Gm: Gymer	Loamy Upland	Favorable	6,000	Big bluestem	30
		Normal	5,000	Little bluestem	20
		Unfavorable	4,000	Indiangrass	15
				Switchgrass	5
				Tall dropseed	5
Hn: Haynie	Loamy Lowland	Favorable	8,500	Big bluestem	40
		Normal	6,500	Eastern gramagrass	15
		Unfavorable	5,000	Switchgrass	10
				Indiangrass	10
				Sedge	5
Hs*:					
Haynie	Loamy Lowland	Favorable	8,500	Big bluestem	40
		Normal	6,500	Eastern gamagrass	15
		Unfavorable	5,000	Switchgrass	10
				Indiangrass	10
				Sedge	5
Sarpy	Sandy Lowland	Favorable	7,000	Sand bluestem	30
		Normal	6,000	Little bluestem	15
		Unfavorable	4,500	Switchgrass	15
				Indiangrass	10
				Eastern gamagrass	10
				Prairie sandreed	5
Kc, Kf: Kennebec	Loamy Lowland	Favorable	9,000	Big bluestem	40
		Normal	7,000	Indiangrass	10
		Unfavorable	6,000	Switchgrass	10
				Eastern gamagrass	10
				Prairie cordgrass	5
Km: Kimo	Clay Lowland	Favorable	9,000	Prairie cordgrass	40
		Normal	7,000	Big bluestem	15
		Unfavorable	5,000	Switchgrass	10
				Indiangrass	5
				Sedge	5
				Eastern gamagrass	5
Mm: Monona	Loamy Upland	Favorable	5,500	Big bluestem	35
		Normal	4,500	Little bluestem	20
		Unfavorable	3,200	Indiangrass	10
				Switchgrass	5
				Porcupinegrass	5

See footnote at end of table.

TABLE 6.--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
Mo, Mr, Mt-------- Morrill	Loamy Upland----------------	Favorable	6,000	Big bluestem----------------	35
		Normal	5,000	Little bluestem-------------	20
		Unfavorable	4,000	Indiangrass-----------------	10
				Switchgrass-----------------	5
				Porcupinegrass--------------	5
Mu---------------- Muir	Loamy Lowland---------------	Favorable	8,000	Big bluestem----------------	40
		Normal	6,000	Indiangrass-----------------	15
		Unfavorable	5,000	Switchgrass-----------------	10
				Eastern gamagrass-----------	10
				Prairie cordgrass-----------	5
				Maximilian sunflower--------	5
Op, Ot------------ Ortello	Sandy-----------------------	Favorable	3,500	Sand bluestem---------------	25
		Normal	3,300	Little bluestem-------------	20
		Unfavorable	3,000	Indiangrass-----------------	15
				Needleandthread-------------	10
				Switchgrass-----------------	10
				Prairie sandreed------------	5
Pe, Pn------------ Pawnee	Clay Upland-----------------	Favorable	6,000	Big bluestem----------------	30
		Normal	4,000	Little bluestem-------------	15
		Unfavorable	3,000	Indiangrass-----------------	15
				Switchgrass-----------------	10
				Tall dropseed---------------	5
				Sideoats grama--------------	5
				Porcupinegrass--------------	5
Po---------------- Pawnee	Clay Upland-----------------	Favorable	5,500	Big bluestem----------------	30
		Normal	3,500	Little bluestem-------------	15
		Unfavorable	2,500	Switchgrass-----------------	15
				Indiangrass-----------------	10
				Tall dropseed---------------	5
				Sideoats grama--------------	5
Re---------------- Reading	Loamy Lowland---------------	Favorable	9,000	Big bluestem----------------	40
		Normal	7,000	Indiangrass-----------------	20
		Unfavorable	6,000	Switchgrass-----------------	10
				Eastern gamagrass-----------	10
				Prairie cordgrass-----------	5
Sf---------------- Sarpy	Sandy Lowland---------------	Favorable	7,000	Sand bluestem---------------	30
		Normal	6,000	Little bluestem-------------	15
		Unfavorable	4,500	Switchgrass-----------------	15
				Indiangrass-----------------	10
				Eastern gamagrass-----------	10
				Prairie sandreed------------	5
Sg---------------- Sharpsburg	Loamy Upland----------------	Favorable	5,500	Big bluestem----------------	35
		Normal	4,400	Little bluestem-------------	20
		Unfavorable	4,000	Switchgrass-----------------	10
				Indiangrass-----------------	10
				Porcupinegrass--------------	5
Th---------------- Thurman	Sands-----------------------	Favorable	5,000	Sand bluestem---------------	25
		Normal	4,000	Little bluestem-------------	15
		Unfavorable	3,000	Indiangrass-----------------	15
				Switchgrass-----------------	10
				Porcupinegrass--------------	5
				Prairie sandreed------------	5

See footnote at end of table.

TABLE 6.--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	Compo- sition
			Lb/acre		Pct
Tu, Tx: Tully	Loamy Upland	Favorable	6,000	Big bluestem	40
		Normal	5,000	Little bluestem	20
		Unfavorable	3,500	Switchgrass	10
				Indiangrass	10
				Eastern gamagrass	5
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
Wd, We: 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
Wg: Wann	Subirrigated	Favorable	6,300	Big bluestem	35
		Normal	5,900	Eastern gamagrass	20
		Unfavorable	5,500	Indiangrass	15
				Switchgrass	10
				Prairie cordgrass	10
				Sedge	5
Wk, Wm, Wn: Wymore	Clay Upland	Favorable	5,000	Big bluestem	35
		Normal	3,600	Little bluestem	15
		Unfavorable	3,200	Indiangrass	15
				Switchgrass	10
				Tall dropseed	5
Ws: Wymore Variant	Loamy Upland	Favorable	4,100	Big bluestem	25
		Normal	3,600	Little bluestem	20
		Unfavorable	3,200	Indiangrass	10
				Switchgrass	10
				Sideoats grama	5
				Missouri goldenrod	5
				Tall dropseed	5
				Sedge	5
Zo: Zook	Clay Lowland	Favorable	9,000	Prairie cordgrass	40
		Normal	7,000	Big bluestem	15
		Unfavorable	6,000	Indiangrass	10
				Switchgrass	10
				Eastern gamagrass	5
				Sedge	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--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				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Common trees	Site index	Volume*	
Ce-------------- Chase	3C	Slight	Moderate	Moderate	Slight	Bur oak------------ Hackberry---------- Green ash---------- Eastern cottonwood-- Black walnut--------	62 60 60 66 55	45 38 51 44 35	Bur oak, green ash, eastern cottonwood, hackberry, black walnut.
Eu-------------- Eudora	10A	Slight	Slight	Slight	Moderate	Eastern cottonwood-- American sycamore--- Hackberry---------- Black walnut-------- Green ash----------	105 --- --- --- ---	141 --- --- --- ---	Eastern cottonwood, green ash, black walnut, hackberry.
Ex**:									
Eudora---------	10A	Slight	Slight	Slight	Moderate	Eastern cottonwood-- American sycamore--- Hackberry---------- Black walnut-------- Green ash----------	105 --- --- --- ---	141 --- --- --- ---	Eastern cottonwood, green ash, black walnut, hackberry.
Kimo-----------	7A	Slight	Moderate	Moderate	Slight	Eastern cottonwood-- White oak---------- Northern red oak---- Hackberry---------- Green ash----------	90 62 --- --- ---	103 45 --- --- ---	Eastern cottonwood, green ash, hackberry.
Hn-------------- Haynie	11A	Slight	Slight	Slight	Moderate	Eastern cottonwood-- American sycamore--- Black walnut-------- Green ash----------	110 82 --- ---	128 83 --- ---	Black walnut, eastern cottonwood, green ash.
Hs**:									
Haynie---------	11A	Slight	Slight	Slight	Moderate	Eastern cottonwood-- American sycamore--- Black walnut-------- Green ash----------	110 82 --- ---	156 83 --- ---	Black walnut, eastern cottonwood, green ash.
Sarpy----------	3S	Slight	Slight	Severe	Slight	Eastern cottonwood--	60	32	Eastern cottonwood, American sycamore, silver maple.
Kc, Kf---------- Kennebec	3A	Slight	Slight	Slight	Moderate	Black walnut-------- Bur oak------------ Hackberry---------- Green ash---------- Eastern cottonwood--	75 63 --- --- ---	47 39 --- --- ---	Black walnut, bur oak, hackberry, green ash, eastern cottonwood, American sycamore.

See footnotes at end of table.

TABLE 7.--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: Volume*	Trees to plant
Km------------- Kimo	7A	Slight	Moderate	Moderate	Slight	Eastern cottonwood--	90	103	Eastern cottonwood, green ash, hackberry.
						White oak----------	62	45	
						Northern red oak----	---	---	
						Hackberry----------	---	---	
						Green ash----------	---	---	
Ps------------- Paxico	11W	Slight	Severe	Moderate	Moderate	Eastern cottonwood--	110	156	Eastern cottonwood, hackberry.
						Hackberry----------	74	46	
						American sycamore---	---	---	
Re------------- Reading	3A	Slight	Slight	Slight	Moderate	Black walnut--------	73	45	Black walnut, green ash, hackberry, bur oak, eastern cottonwood, northern red oak.
						Bur oak------------	60	38	
						Hackberry----------	69	42	
						Shagbark hickory----	62	39	
						Northern red oak----	---	---	
Sf------------- Sarpy	3S	Slight	Slight	Severe	Slight	Eastern cottonwood--	60	32	Eastern cottonwood, American sycamore.
Tz------------- Tuttle	2R	Moderate	Moderate	Moderate	Moderate	Chinkapin oak-------	50	34	Bur oak, chinkapin oak, hackberry, bitternut hickory, green ash.
						Bitternut hickory---	---	---	
						Green ash----------	---	---	
						Hackberry----------	---	---	
						Eastern redbud------	---	---	
						Slippery elm--------	---	---	
Wb------------- Wabash	5W	Slight	Severe	Severe	Severe	Green ash----------	70	75	Eastern cottonwood, hackberry.
						Hackberry----------	66	41	
						Eastern cottonwood--	---	---	

* Volume is the yield in cubic feet per acre 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 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Bd------------- Benfield	Siberian peashrub, Peking cotoneaster, lilac.	Amur honeysuckle, Manchurian crabapple.	Eastern redcedar, Austrian pine, Russian-olive, hackberry, green ash.	Siberian elm, honeylocust.	---
Bf*:					
Benfield---------	Siberian peashrub, Peking cotoneaster, lilac.	Amur honeysuckle, Manchurian crabapple.	Eastern redcedar, Austrian pine, Russian-olive, hackberry, green ash.	Siberian elm, honeylocust.	---
Florence---------	Lilac, Peking cotoneaster, Amur honeysuckle, fragrant sumac.	---	Eastern redcedar, hackberry, bur oak, Austrian pine, green ash, Russian-olive.	Honeylocust, Siberian elm.	---
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------------- Clime	Fragrant sumac, Tatarian honeysuckle.	Siberian peashrub	Eastern redcedar, green ash, osageorange, Russian-olive, black locust, honeylocust, northern catalpa, bur oak.	Siberian elm------	---
Cs*:					
Clime------------	Fragrant sumac, Tatarian honeysuckle.	Siberian peashrub	Eastern redcedar, green ash, osageorange, Russian-olive, black locust, honeylocust, northern catalpa, bur oak.	Siberian elm------	---
Sogn.					
Em, Eo----------- Elmont	Peking cotoneaster	Lilac, fragrant sumac, Amur honeysuckle.	Eastern redcedar, Russian-olive, hackberry, green ash, bur oak.	Austrian pine, Scotch pine, honeylocust.	---

See footnote at end of table.

TABLE 8.--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
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.
Gm----------------- Gymer	Lilac, Peking cotoneaster.	Manchurian crabapple, Siberian peashrub, Amur honeysuckle.	Eastern redcedar, Austrian pine, Russian-olive, hackberry, green ash.	Siberian elm, honeylocust.	---
Hn----------------- Haynie	Blackhaw----------	Tatarian honeysuckle, Siberian peashrub.	Russian-olive, osageorange, eastern redcedar, Washington hawthorn.	Green ash, hackberry, honeylocust, bur oak.	Eastern cottonwood.
Hs*: Haynie-----------	Blackhaw----------	Tatarian honeysuckle, Siberian peashrub.	Russian-olive, osageorange, eastern redcedar, Washington hawthorn.	Green ash, hackberry, honeylocust, bur oak.	Eastern cottonwood.
Sarpy------------	Blackhaw----------	Tatarian honeysuckle, Siberian peashrub.	Washington hawthorn, Russian-olive, eastern redcedar, osageorange.	Hackberry, green ash, honeylocust, bur oak.	Eastern cottonwood.
Kc, Kf------------ Kennebec	---	Amur maple, Amur honeysuckle, lilac, autumn-olive.	Eastern redcedar	Austrian pine, hackberry, pin oak, green ash, honeylocust.	Eastern white pine, eastern cottonwood.
Km----------------- 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 8.--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
Mm: Monona	---	Autumn-olive, lilac, Amur maple, Amur honeysuckle.	Bur oak, hackberry, green ash, Russian-olive, eastern redcedar.	Honeylocust, eastern white pine, Austrian pine.	---
Mo, Mr, Mt: Morrill	Peking cotoneaster	Amur honeysuckle, lilac, fragrant sumac.	Green ash, hackberry, Russian-olive, eastern redcedar, bur oak.	Austrian pine, honeylocust, Scotch pine.	---
Mu: Muir	---	Peking cotoneaster, Amur honeysuckle, American plum, lilac.	Eastern redcedar	Eastern white pine, honeylocust, bur oak, Austrian pine, green ash, hackberry.	Eastern cottonwood.
Op, Ot: Ortello	Skunkbush sumac	American plum, Siberian peashrub, Tatarian honeysuckle, lilac.	Eastern redcedar, honeylocust, ponderosa pine, Russian-olive, hackberry, green ash.	---	Siberian elm.
Pe, Pn, Po: Pawnee	Amur honeysuckle, lilac, Siberian peashrub, Peking cotoneaster.	Eastern redcedar, Manchurian crabapple.	Austrian pine, Russian-olive, green ash, hackberry, honeylocust.	Siberian elm	---
Ps. Paxico					
Pt*. Pits					
Re: Reading	---	Lilac, American plum, Peking cotoneaster, Amur honeysuckle.	Eastern redcedar	Austrian pine, bur oak, green ash, honeylocust, eastern white pine, hackberry.	Eastern cottonwood.
Sf: Sarpy	Blackhaw	Siberian peashrub, Tatarian honeysuckle, Washington hawthorn.	Eastern redcedar, Russian-olive, osageorange.	Bur oak, hackberry, green ash, honeylocust.	Eastern cottonwood.
Sg: Sharpsburg	---	Amur maple, Amur honeysuckle, lilac, autumn-olive.	Green ash, hackberry, bur oak, eastern redcedar, Russian-olive.	Austrian pine, eastern white pine, honeylocust.	---

See footnote at end of table.

TABLE 8.--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
Th----------------- Thurman	Amur honeysuckle, skunkbush sumac, lilac.	Eastern redcedar, Manchurian crabapple, Russian-olive, Siberian peashrub.	Ponderosa pine, green ash, honeylocust, hackberry.	Siberian elm------	---
Tu, Tx------------ Tully	Peking cotoneaster	Lilac, fragrant sumac, Amur honeysuckle.	Eastern redcedar, Russian-olive, hackberry, green ash, bur oak.	Austrian pine, honeylocust, Scotch pine.	---
Tz----------------- Tuttle	Fragrant sumac, Siberian peashrub, Tatarian honeysuckle.	---	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.
Wd, We------------ Wamego	Amur honeysuckle, lilac, Peking cotoneaster, fragrant sumac.	---	Eastern redcedar, Austrian pine, hackberry, green ash, bur oak, Russian-olive.	Honeylocust, Siberian elm.	---
Wg----------------- Wann	---	Siberian peashrub, lilac, Tatarian honeysuckle.	Eastern redcedar, ponderosa pine, hackberry, blue spruce.	Green ash, honeylocust, golden willow, silver maple.	Eastern cottonwood.
Wk, Wm, Wn-------- Wymore	Peking cotoneaster, skunkbush sumac, lilac.	Manchurian crabapple, Amur honeysuckle.	Eastern redcedar, Austrian pine, ponderosa pine, Russian-olive, hackberry, green ash.	Honeylocust-------	---
Ws----------------- Wymore Variant	Peking cotoneaster, skunkbush sumac, lilac.	Manchurian crabapple, Amur honeysuckle.	Eastern redcedar, Austrian pine, ponderosa pine, Russian-olive, hackberry, green ash.	Honeylocust-------	---
Zo----------------- Zook	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Honeylocust, golden willow, green ash, northern red oak, silver maple, Austrian pine.	Eastern cottonwood.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Bd: Benfield	Slight	Slight	Moderate: slope, small stones.	Slight.
Bf*: Benfield	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
Florence	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Severe: small stones.
Ce: Chase	Severe: flooding.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Slight.
Cm: Clime	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
Cs*: Clime	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
Sogn	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
Em, 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.
Gm: Gymer	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight.
Hn: Haynie	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Hs*: Haynie	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Sarpy	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Kc: Kennebec	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
Kf: Kennebec	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Km: Kimo	Severe: flooding, too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
Mm: Monona	Slight	Slight	Severe: slope.	Slight.
Mo, Mr: Morrill	Slight	Slight	Moderate: slope.	Slight.
Mt: Morrill	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Mu: Muir	Severe: flooding.	Slight	Slight	Slight.
Op: Ortello	Slight	Slight	Moderate: slope.	Slight.
Ot: Ortello	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Pe, Pn: Pawnee	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
Po: Pawnee	Severe: too clayey, wetness.	Severe: too clayey.	Severe: too clayey, wetness.	Severe: too clayey.
Ps: Paxico	Severe: flooding.	Moderate: flooding, wetness.	Severe: flooding.	Moderate: flooding.
Pt*. Pits				
Re: Reading	Severe: flooding.	Moderate: percs slowly.	Moderate: percs slowly.	Slight.
Sf: Sarpy	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy, flooding.	Severe: too sandy.
Sg: Sharpsburg	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight.
Th: Thurman	Slight	Slight	Moderate: slope.	Slight.
Tu: Tully	Slight	Slight	Moderate: slope, small stones.	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Tx: Tully	Moderate: slope.	Moderate: slope, too clayey.	Severe: slope.	Severe: erodes easily.
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.
Wd: Wamego	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, depth to rock, percs slowly.	Slight.
We: Wamego	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight.
Wg: Wann	Severe: flooding.	Moderate: flooding, wetness.	Severe: flooding.	Moderate: wetness, flooding.
Wk, Wm, Wn: Wymore	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
Ws: Wymore Variant	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.
Zo: Zook	Severe: wetness, flooding.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

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
Bd----------------- Benfield	Fair	Good	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Bf*:												
Benfield-----------	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Florence-----------	Poor	Good	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
Ce----------------- Chase	Good	Good	Good	Good	Good	Good	Good	Fair	Good	Good	Fair	---
Cm----------------- 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.
Em, 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	---
Gm----------------- Gymer	Fair	Good	Fair	Good	Good	Good	Poor	Very poor.	Fair	---	Very poor.	Fair.
Hn----------------- Haynie	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
Hs*:												
Haynie-------------	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
Sarpy--------------	Poor	Poor	Fair	Poor	Poor	---	Very poor.	Very poor.	Poor	Poor	Very poor.	---
Kc----------------- Kennebec	Poor	Poor	Good	Good	Good	---	Poor	Poor	Poor	Good	Poor	---
Kf----------------- Kennebec	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
Km----------------- Kimo	Fair	Fair	Good	Fair	Fair	Fair	Good	Good	Fair	Fair	Good	---

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hard-wood trees	Conif-erous plants	Shrubs	Wetland plants	Shallow water areas	Open-land wild-life	Wood-land wild-life	Wetland wild-life	Range-land wild-life
Mm: Monona	Good	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.	---
Mo, Mr, Mt: Morrill	Fair	Good	Good	Fair	Fair	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
Mu: Muir	Good	Good	Good	Good	Fair	Good	Poor	Very poor.	Good	Good	Very poor.	Good.
Op: Ortello	Fair	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Ot: Ortello	Fair	Good	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.	Good.
Pe, Pn: Pawnee	Fair	Good	Good	---	Fair	Fair	Very poor.	Poor	Good	---	Poor	Fair.
Po: Pawnee	Fair	Fair	Good	---	Fair	Fair	Very poor.	Poor	Fair	---	Poor	Fair.
Ps: Paxico	Poor	Fair	Fair	Good	Good	---	Good	Good	Fair	Good	Fair	---
Pt*. Pits												
Re: Reading	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	---
Sf: Sarpy	Poor	Poor	Fair	Poor	Poor	---	Very poor.	Very poor.	Poor	Poor	Very poor.	---
Sg: Sharpsburg	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
Th: Thurman	Fair	Good	Good	Fair	Fair	Good	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
Tu, Tx: Tully	Fair	Good	Good	---	---	Fair	Poor	Poor	Fair	---	Poor	Fair.
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	---
Wd: Wamego	Fair	Good	Fair	Fair	Fair	Good	Poor	Very poor.	Fair	Fair	Very poor.	Fair.
We: Wamego	Poor	Fair	Fair	Fair	Fair	Good	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
Wg: Wann	Good	Good	Good	Good	Fair	Good	Poor	Fair	Good	Good	Fair	Good.
Wk: Wymore	Good	Good	Fair	Good	Good	Fair	Poor	Very poor.	Good	Good	Very poor.	Fair.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Wm, Wn------------- Wymore	Fair	Good	Fair	Good	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.	Fair.
Ws----------------- Wymore Variant	Good	Good	Fair	Good	Good	Fair	Poor	Very poor.	Good	Good	Very poor.	Fair.
Zo----------------- Zook	Good	Fair	Good	Fair	Poor	---	Good	Good	Fair	Fair	Good	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Bd: Benfield	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Bf*:					
Benfield	Moderate: depth to rock, too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.
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.
Ce: Chase	Severe: wetness.	Severe: flooding, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, frost action.
Cm: Clime	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
Cs*:					
Clime	Moderate: depth to rock, too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, 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.
Em, 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.
Gm: Gymer	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Hn----------------- Haynie	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding, frost action.
Hs*:					
Haynie------------	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding, frost action.
Sarpy-------------	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Kc, Kf------------ Kennebec	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, frost action, low strength.
Km----------------- Kimo	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: frost action.
Mm----------------- Monona	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: low strength, frost action.
Mo, Mr------------ Morrill	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, frost action.
Mt----------------- Morrill	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: low strength, slope, frost action.
Mu----------------- Muir	Slight-----------	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.
Op----------------- Ortello	Severe: cutbanks cave.	Slight-----------	Slight-----------	Moderate: slope.	Moderate: frost action.
Ot----------------- Ortello	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.
Pe, Pn, Po-------- Pawnee	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: low strength, frost action, shrink-swell.
Ps----------------- Paxico	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding, frost action.
Pt*. Pits					
Re----------------- Reading	Moderate: too clayey.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, frost action.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Sf----------------- Sarpy	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Sg----------------- Sharpsburg	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.
Th----------------- Thurman	Severe: cutbanks cave.	Slight-----------	Slight-----------	Moderate: slope.	Slight.
Tu----------------- Tully	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Tx----------------- Tully	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.
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: low strength, wetness, flooding.
Wd----------------- Wamego	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
We----------------- Wamego	Moderate: depth to rock, too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Severe: low strength.
Wg----------------- Wann	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding, frost action.
Wk, Wm, Wn--------- Wymore	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, frost action.
Ws----------------- Wymore Variant	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell.
Zo----------------- Zook	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, low strength, frost action.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Bd----------------- Benfield	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
Bf*:					
Benfield-----------	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
Florence-----------	Severe: percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock, slope.	Poor: too clayey, hard to pack, small stones.
Ce----------------- Chase	Severe: wetness, percs slowly.	Slight-----------	Severe: too clayey.	Moderate: flooding, wetness.	Poor: too clayey, hard to pack.
Cm----------------- Clime	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: depth to rock, too clayey, hard to pack.
Cs*:					
Clime--------------	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
Sogn---------------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Em, Eo------------- Elmont	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	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.
Gm----------------- Gymer	Severe: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Hn: Haynie	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
Hs*:					
Haynie	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
Sarpy	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, too sandy.	Severe: flooding, seepage.	Poor: seepage, too sandy.
Kc, Kf: Kennebec	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.
Km: Kimo	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
Mm: Monona	Slight	Severe: slope.	Slight	Slight	Good.
Mo, Mr: Morrill	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Mt: Morrill	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Mu: Muir	Moderate: flooding.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
Op: Ortello	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Ot: Ortello	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Pe, Pn, Po: Pawnee	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey, wetness.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Ps: Paxico	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Fair: wetness, thin layer.
Pt*. Pits					
Re: Reading	Severe: percs slowly.	Slight	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey, thin layer.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Sf: Sarpy	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, too sandy.	Severe: flooding, seepage.	Poor: seepage, too sandy.
Sg: Sharpsburg	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Th: Thurman	Severe: poor filter.	Severe: seepage.	Severe: too sandy, seepage.	Severe: seepage.	Poor: too sandy, seepage.
Tu: Tully	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
Tx: Tully	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
Tz: Tuttle	Severe: percs slowly, slope.	Severe: slope.	Severe: depth to rock, 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.
Wd: Wamego	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey.
We: Wamego	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey.
Wg: Wann	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Fair: wetness, thin layer.
Wk: Wymore	Severe: wetness, percs slowly.	Slight	Severe: wetness.	Severe: wetness.	Poor: hard to pack, wetness.
Wm, Wn: Wymore	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness.	Severe: wetness.	Poor: hard to pack, wetness.
Ws: Wymore Variant	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: seepage, wetness.	Poor: too clayey, hard to pack, wetness.
Zo: Zook	Severe: percs slowly, wetness, flooding.	Severe: flooding.	Severe: wetness, too clayey, flooding.	Severe: wetness, flooding.	Poor: too clayey, wetness, hard to pack.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Bd: Benfield	Poor: depth to rock, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Bf*:				
Benfield	Poor: depth to rock, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Florence	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
Ce: Chase	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Cm: Clime	Poor: depth to rock, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Cs*:				
Clime	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Sogn	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
Em, Eo: Elmont	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, 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.
Gm: Gymer	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Hn: Haynie	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Hs*:				
Haynie	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Hs*:				
Sarpy	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Kc, Kf Kennebec	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Km Kimo	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Mm Monona	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Mo, Mr Morrill	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Mt Morrill	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Mu Muir	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Op Ortello	Good	Probable	Improbable: too sandy.	Fair: thin layer.
Ot Ortello	Good	Probable	Improbable: too sandy.	Fair: thin layer, slope.
Pe, Pn Pawnee	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Po Pawnee	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Ps Paxico	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Pt*. Pits				
Re Reading	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Sf Sarpy	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Sg Sharpsburg	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Th Thurman	Good	Probable	Improbable: too sandy.	Poor: area reclaim.
Tu Tully	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Tx: Tully	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones.
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: too clayey, wetness.
Wd, We: Wamego	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Wg: Wann	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
Wk, Wm, Wn: Wymore	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Ws: Wymore Variant	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Zo: Zook	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Bd----------------- Benfield	Moderate: depth to rock, slope.	Moderate: thin layer, hard to pack.	Deep to water	Percs slowly, depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
Bf*:						
Benfield----------	Severe: slope.	Moderate: thin layer, hard to pack.	Deep to water	Percs slowly, depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Florence----------	Severe: slope.	Severe: hard to pack.	Deep to water	Large stones, droughty, slope.	Slope, large stones.	Large stones, slope, droughty.
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	Severe: slope.	Moderate: thin layer, hard to pack.	Deep to water	Percs slowly, depth to rock.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Cs*:						
Clime--------------	Severe: slope.	Moderate: thin layer, hard to pack.	Deep to water	Percs slowly, depth to rock.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Sogn---------------	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
Em, Eo------------- Elmont	Moderate: depth to rock, 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.
Gm----------------- Gymer	Moderate: slope.	Moderate: hard to pack.	Deep to water	Slope-----------	Erodes easily	Erodes easily.
Hn----------------- Haynie	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily, flooding.	Erodes easily	Erodes easily.
Hs*:						
Haynie-------------	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily, flooding.	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 14.--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
Hs*: Sarpy	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Kc, Kf Kennebec	Moderate: seepage.	Moderate: thin layer, piping, wetness.	Deep to water	Flooding	Favorable	Favorable.
Km Kimo	Moderate: seepage.	Severe: piping.	Percs slowly, frost action.	Wetness, percs slowly, slow intake.	Erodes easily, wetness.	Erodes easily, percs slowly.
Mm Monona	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
Mo, Mr Morrill	Moderate: seepage, slope.	Severe: thin layer.	Deep to water	Slope	Favorable	Favorable.
Mt Morrill	Severe: slope.	Severe: thin layer.	Deep to water	Slope	Slope	Slope.
Mu Muir	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Favorable	Favorable.
Op Ortello	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope	Too sandy, soil blowing.	Favorable.
Ot Ortello	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope	Slope, too sandy, soil blowing.	Slope.
Pe, Pn Pawnee	Moderate: slope.	Severe: hard to pack.	Percs slowly, frost action, slope.	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily.
Po Pawnee	Moderate: slope.	Severe: hard to pack.	Percs slowly, frost action, slope.	Slow intake, percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily.
Ps Paxico	Moderate: seepage.	Severe: piping, wetness.	Flooding, frost action.	Wetness, soil blowing, erodes easily.	Erodes easily, wetness, soil blowing.	Erodes easily.
Pt*. Pits						
Re Reading	Moderate: seepage.	Slight	Deep to water	Favorable	Erodes easily	Erodes easily.
Sf Sarpy	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Sg Sharpsburg	Moderate: seepage.	Slight	Deep to water	Favorable	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 14.--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
Th----------------- Thurman	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Tu----------------- Tully	Moderate: slope.	Moderate: hard to pack.	Deep to water	Percs slowly, slope.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Tx----------------- Tully	Severe: slope.	Moderate: hard to pack.	Deep to water	Percs slowly, slope, slow intake.	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
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.
Wd----------------- Wamego	Moderate: depth to rock, slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
We----------------- Wamego	Severe: slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Wg----------------- Wann	Severe: seepage.	Severe: piping, wetness.	Flooding, frost action.	Wetness, soil blowing.	Wetness, soil blowing.	Slight.
Wk, Wm------------ Wymore	Slight---------	Moderate: hard to pack, wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Erodes easily, wetness.	Wetness, erodes easily.
Wn----------------- Wymore	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly.	Erodes easily, wetness.	Wetness, erodes easily.
Ws----------------- Wymore Variant	Slight---------	Moderate: hard to pack, wetness.	Percs slowly---	Wetness, soil blowing, percs slowly.	Erodes easily, wetness, soil blowing.	Wetness, erodes easily, percs slowly.
Zo----------------- Zook	Slight---------	Severe: hard to pack, wetness.	Flooding, percs slowly, frost action.	Wetness, percs slowly.	Not needed-----	Not needed.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--SOIL POTENTIAL RATINGS FOR DWELLINGS WITH BASEMENTS

Soil name and map symbol	Limitations	Soil potential (index) and corrective treatment	Continuing management needs
Bd: Benfield	Shrink-swell, depth to rock.	Low (62): Add extra reinforcement in basement walls and nonexpansive backfill; slope the excavation walls.	None.
Bf*:			
Benfield	Shrink-swell, depth to rock.	Low (62): Add extra reinforcement in basement walls and nonexpansive backfill; slope the excavation walls.	None.
Florence	Slope, shrink-swell, large stones.	Low (80): Level area; add compacted backfill and additional fill material.	None.
Ce: Chase	Flooding, wetness, shrink-swell.	Very low (48): Add fill material, basement wall lining, base drains with sump pump, extra reinforcement in basement walls, pilings, and nonexpansive backfill; slope the excavation walls.	Maintain drainage system.
Cm: Clime	Slope, shrink-swell, depth to rock.	Low (83): Level area; add compacted backfill.	None.
Cs*:			
Clime	Slope, shrink-swell, depth to rock.	Low (87): Level area; add compacted backfill.	None.
Sogn	Slope, depth to rock.	Very low (50): Level area.	None.
Em: Elmont	Shrink-swell, depth to rock.	High (93): Add compacted backfill.	None.
Eo: Elmont	Shrink-swell, depth to rock.	High (93): Add compacted backfill.	None.
Eu: Eudora	Flooding	Medium (91): Add fill material.	Flood control.
Ex*:			
Eudora	Flooding	Medium (91): Add fill material.	Flood control.
Kimo	Flooding, wetness.	Low (74): Add fill material, base drains with sump pump, and basement wall lining.	Maintain drainage system.
Gm: Gymer	Shrink-swell	High (94): Add compacted backfill.	None.
Hn: Haynie	Flooding	Low (78): Construct flood-control system; add fill material.	Maintain flood-control system.

See footnote at end of table.

TABLE 15.--SOIL POTENTIAL RATINGS FOR DWELLINGS WITH BASEMENTS--Continued

Soil name and map symbol	Limitations	Soil potential (index) and corrective treatment	Continuing management needs
Hs*:			
Haynie	Flooding	Low (78): Construct flood-control system; add fill material.	Maintain flood-control system.
Sarpy	Flooding	Low (78): Construct flood-control system; add fill material.	Maintain flood-control system.
Kc: Kennebec	Flooding, wetness, shrink-swell.	Very low (36): Construct flood-control system; add fill material, base drains with sump pump, basement wall lining, pilings, and compacted backfill.	Maintain flood-control and drainage systems.
Kf: Kennebec	Flooding, wetness, shrink-swell.	Low (64): Construct flood-control system; add fill material, base drains with sump pump, basement wall lining, pilings, and compacted backfill.	Maintain flood-control and drainage systems.
Km: Kimo	Flooding, wetness.	Low (74): Add fill material, base drains with sump pump, pilings, and basement wall lining.	Maintain drainage system.
Mm: Monona	Slope, shrink-swell.	Medium (89): Level area; add compacted backfill.	None.
Mo, Mr: Morrill	Shrink-swell	High (94): Add compacted backfill.	None.
Mt: Morrill	Slope, shrink-swell, large stones.	Medium (88): Level area; add compacted backfill and additional fill material.	None.
Mu: Muir	Flooding	Medium (91): Add fill material.	Flood control.
Op: Ortello	None	Very high (100): None.	None.
Ot: Ortello	Slope	High (95): Level area.	None.
Pe, Pn, Po: Pawnee	Shrink-swell, wetness.	Low (56): Add extra reinforcement in basement walls, nonexpansive backfill, base drains with sump pump, and basement wall lining; slope the excavation walls.	Maintain drainage system.
Ps: Paxico	Flooding, wetness.	Very low (37): Construct flood-control system; add fill material, base drains with sump pump, pilings, and basement wall lining.	Maintain flood-control and drainage systems.
Pt*. Pits			

See footnote at end of table.

TABLE 15.--SOIL POTENTIAL RATINGS FOR DWELLINGS WITH BASEMENTS--Continued

Soil name and map symbol	Limitations	Soil potential (index) and corrective treatment	Continuing management needs
Re: Reading	Flooding, shrink-swell.	Medium (91): Add fill material and compacted backfill.	Flood control.
Sf: Sarpy	Flooding	Very low (50): Construct flood-control system; add fill material.	Maintain flood-control system.
Sg: Sharpsburg	Shrink-swell	High (94): Add compacted backfill.	None.
Th: Thurman	None	Very high (100): None.	None.
Tu, Tx: Tully	Shrink-swell	Low (64): Add extra reinforcement in basement walls and nonexpansive backfill; slope the excavation walls.	None.
Tz: Tuttle	Slope, shrink-swell, depth to rock, large stones.	Low (84): Level area; add compacted backfill and additional fill material.	None.
Wb: Wabash	Flooding, shrink-swell, wetness.	Very low (26): Construct flood-control system; add fill material, extra reinforcement in basement walls, nonexpansive backfill, base drains with sump pump, basement wall lining and pilings; slope the excavation walls.	Maintain flood-control and drainage systems.
Wd: Wamego	Shrink-swell, depth to rock.	Medium (92): Add compacted backfill.	None.
We: Wamego	Shrink-swell, slope, depth to rock.	Medium (87): Add compacted backfill; level area.	None.
Wg: Wann	Flooding, wetness.	Very low (37): Construct flood-control system; add fill material, base drains with sump pump, basement wall lining, and pilings.	Maintain flood-control and drainage systems.
Wk, Wm, Wn: Wymore	Shrink-swell, wetness.	Low (56): Add extra reinforcement in basement walls, nonexpansive backfill, and base drains with sump pump; slope the excavation walls.	Maintain drainage system.
Ws: Wymore Variant	Shrink-swell, wetness.	Low (56): Add extra reinforcement in basement walls, nonexpansive backfill, and base drains with sump pump; slope the excavation walls.	Maintain drainage system.

See footnote at end of table.

TABLE 15.--SOIL POTENTIAL RATINGS FOR DWELLINGS WITH BASEMENTS--Continued

Soil name and map symbol	Limitations	Soil potential (index) and corrective treatment	Continuing management needs
Zo: Zook	Flooding, wetness, shrink-swell.	Very low (26): Construct flood-control system; add fill material, base drains with sump pump, basement wall lining, pilings, extra reinforcement in basement walls, and nonexpansive backfill; slope the excavation walls.	Maintain flood-control and drainage systems.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL POTENTIAL RATINGS FOR DWELLINGS WITHOUT BASEMENTS

Soil name and map symbol	Limitations	Soil potential (index) and corrective treatment	Continuing management needs
Bd: Benfield	Shrink-swell, depth to rock.	Medium (88): Add foundation footings, thicker slab with extra reinforcement, compacted backfill, and sand subgrade.	None.
Bf*:			
Benfield	Shrink-swell, depth to rock, slope.	Low (85): Add foundation footings, thicker slab with extra reinforcement, compacted backfill, and sand subgrade; level area.	None.
Florence	Shrink-swell, slope, large stones.	Low (86): Add foundation footings, thicker slab with extra reinforcement, compacted backfill, and sand subgrade; level area.	None.
Ce: Chase	Flooding, shrink-swell, wetness.	Low (78): Add fill material, foundation footings, thicker slab with extra reinforcement, compacted backfill and sand subgrade; install interceptor tile around foundation footings.	Maintain surface drainage system.
Cm: Clime	Shrink-swell depth to rock, slope, large stones.	Low (85): Add compacted backfill and sand subgrade; level area.	None.
Cs*:			
Clime	Shrink-swell, depth to rock, slope.	Low (83): Add compacted backfill and sand subgrade; level area.	None.
Sogn	Depth to rock, slope.	Medium (90): Level area.	None.
Em, Eo: Elmont	Shrink-swell	High (95): Add compacted backfill and sand subgrade.	None.
Eu: Eudora	Flooding	Medium (90): Add fill material.	Flood control.
Ex*:			
Eudora	Flooding	Medium (90): Add fill material.	Flood control.
Kimo	Flooding, wetness.	Medium (89): Add fill material; install interceptor tile around foundation footings.	Maintain surface drainage system.
Gm: Gymer	Shrink-swell	High (95): Add compacted backfill and sand subgrade.	None.

See footnote at end of table.

TABLE 16.--SOIL POTENTIAL RATINGS FOR DWELLINGS WITHOUT BASEMENTS--Continued

Soil name and map symbol	Limitations	Soil potential (index) and corrective treatment	Continuing management needs
Hn: Haynie	Flooding	Low (78): Construct flood-control system; add fill material.	Maintain flood-control system.
Hs*:			
Haynie	Flooding	Low (78): Construct flood-control system; add fill material.	Maintain flood-control system.
Sarpy	Flooding	Low (78): Construct flood-control system; add fill material.	Maintain flood-control system.
Kc: Kennebec	Flooding, shrink-swell.	Very low (45): Construct flood-control system; add fill material, compacted backfill, and sand subgrade.	Maintain flood-control system.
Kf: Kennebec	Flooding, shrink-swell.	Low (73): Construct flood-control system; add fill material, compacted backfill, and sand subgrade.	Maintain flood-control system.
Km: Kimo	Flooding, wetness.	Medium (89): Add fill material; install interceptor tile around foundation footings.	Maintain surface drainage system.
Mm: Monona	Shrink-swell, slope.	Medium (90): Add compacted backfill and sand subgrade; level area.	None.
Mo, Mr: Morrill	Shrink-swell	High (95): Add compacted backfill and sand subgrade.	None.
Mt: Morrill	Shrink-swell, slope, large stones.	Medium (89): Add compacted backfill and sand subgrade; level area.	None.
Mu: Muir	Flooding	Medium (90): Add fill material.	Flood control.
Op: Ortello	None	Very high (100): None.	None.
Ot: Ortello	Slope	High (95): Level area.	None.
Pe, Pn, Po: Pawnee	Shrink-swell, wetness.	Low (84): Add foundation footings, thicker slab with extra reinforcement, compacted backfill, and sand subgrade; install interceptor tile around foundation footings.	None.
Ps: Paxico	Flooding, wetness.	Very low (42): Construct flood-control system; add fill material; install interceptor tile around foundation footings.	Maintain flood-control system.

See footnote at end of table.

TABLE 16.--SOIL POTENTIAL RATINGS FOR DWELLINGS WITHOUT BASEMENTS--Continued

Soil name and map symbol	Limitations	Soil potential (index) and corrective treatment	Continuing management needs
Pt*. Pits			
Re----------------- Reading	Flooding, shrink-swell.	Medium (90): Add fill material, compacted backfill, and sand subgrade.	Flood control.
Sf----------------- Sarpy	Flooding-----------------	Very low (50): Construct flood-control system; add fill material.	Maintain flood-control system.
Sg----------------- Sharpsburg	Shrink-swell-------------	High (95): Add compacted backfill and sand subgrade.	None.
Th----------------- Thurman	None---------------------	Very high (100): None.	None.
Tu, Tx------------- Tully	Shrink-swell-------------	Medium (89): Add foundation footings, thicker slab with extra reinforcement, compacted backfill, and sand subgrade.	None.
Tz----------------- Tuttle	Shrink-swell, slope, large stones.	Low (86): Add compacted backfill and sand subgrade; level area.	None.
Wb----------------- Wabash	Flooding, shrink-swell, wetness.	Very low (51): Construct flood-control system; add fill material, foundation footings, thicker slab with extra reinforcement, compacted backfill, and sand subgrade; install interceptor tile around foundation footings.	Maintain flood-control and surface drainage systems.
Wd----------------- Wamego	Shrink-swell-------------	Medium (95): Add compacted backfill and sand subgrade.	None.
We----------------- Wamego	Shrink-swell, slope.	Medium (90): Add compacted backfill and sand subgrade; level area.	None.
Wg----------------- Wann	Flooding, wetness.	Very low (42): Construct flood-control system; add fill material; install interceptor tile around foundation footings.	Maintain flood-control and surface drainage systems.
Wk, Wm, Wn--------- Wymore	Shrink-swell, wetness.	Low (84): Add foundation footings, thicker slab with extra reinforcement, compacted backfill, and sand subgrade; install interceptor tile around foundation footings.	Maintain surface drainage systems.
Ws----------------- Wymore Variant	Shrink-swell, wetness.	Low (84): Add foundation footings, thicker slab with extra reinforcement, compacted backfill, and sand subgrade; install interceptor tile around foundation footings.	Maintain surface drainage system.

See footnote at end of table.

TABLE 16.--SOIL POTENTIAL RATINGS FOR DWELLINGS WITHOUT BASEMENTS--Continued

Soil name and map symbol	Limitations	Soil potential (index) and corrective treatment	Continuing management needs
Zo------------------ Zook	Flooding, shrink-swell, wetness.	Very low (51): Construct flood-control system; add fill material, foundation footings, thicker slab with extra reinforcement, compacted backfill, and sand subgrade; install interceptor tile around foundation footings.	Maintain flood-control and surface drainage systems.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL POTENTIAL RATINGS FOR SEPTIC TANK ABSORPTION FIELDS

Soil name and map symbol	Limitations	Soil potential (index) and corrective treatment	Continuing limitations
Bd------------------ Benfield	Percs slowly, depth to rock.	Low (33): Use alternative system.*	
Bf**:			
Benfield-----------	Percs slowly, depth to rock.	Very low (33): Use alternative system.*	
Florence-----------	Slope, percs slowly.	Low (60): Use alternative system.*	
Ce------------------ Chase	Percs slowly, flooding, wetness.	Very low (20): Use alternative system.*	
Cm------------------ Clime	Percs slowly, slope, depth to rock, large stones.	Very low (15): Use alternative system.*	
Cs**:			
Clime--------------	Percs slowly, slope, depth to rock, large stones.	Very low (28): Use alternative system.*	
Sogn---------------	Slope, depth to rock.	Very low (21): Use alternative system.	
Em------------------ Elmont	Percs slowly, depth to rock.	Low (33): Use alternative system.*	
Eo------------------ Elmont	Percs slowly, depth to rock.	Low (33): Use alternative system.*	
Eu------------------ Eudora	Flooding------------------	Low (57): Use alternative system.***	
Ex**:			
Eudora-------------	Flooding------------------	Low (57): Use alternative system.***	
Kimo---------------	Flooding, wetness.	Low (52): Use alternative system.***	
Gm------------------ Gymer	Percs slowly--------------	Low (60): Use alternative system.*	
Hn------------------ Haynie	Flooding------------------	Low (47): Use alternative system.***	
Hs**:			
Haynie-------------	Flooding------------------	Low (47): Use alternative system.***	
Sarpy--------------	Flooding, poor filter.	Very low (30): Use alternative system.***	
Kc------------------ Kennebec	Flooding, wetness.	Very low (9): Use alternative system.***	

See footnotes at end of table.

TABLE 17.--SOIL POTENTIAL RATINGS FOR SEPTIC TANK ABSORPTION FIELDS--Continued

Soil name and map symbol	Limitations	Soil potential (index) and corrective treatment	Continuing limitations
Kf: Kennebec	Flooding, wetness.	Low (35): Use alternative system.***	
Km: Kimo	Flooding, wetness.	Low (52): Use alternative system.***	
Mm: Monona	None	Very high (100): None.	None.
Mo, Mr: Morrill	None	Very high (100): None.	None.
Mt: Morrill	Slope, large stones.	Very high (93): Land shaping.	Surfacing of effluent.
Mu: Muir	Flooding	Low (57): Use alternative system.***	
Op: Ortello	None	Very high (100): None.	None.
Ot: Ortello	Slope	Very high (96): Land shaping.	Possible surfacing of effluent.
Pe, Pn, Po: Pawnee	Percs slowly, wetness.	Low (33): Use alternative system.*	
Ps: Paxico	Flooding, wetness.	Very low (0): Use alternative system.***	
Pt*. Pits			
Re: Reading	Flooding	Low (57): Use alternative system.***	
Sf: Sarpy	Flooding, poor filter.	Very low (9): Use alternative system.***	
Sg: Sharpsburg	None	Very high (100): None.	None.
Th: Thurman	Poor filter	Medium (73): Use alternative system.	Possible contamination of ground water.
Tu, Tx: Tully	Percs slowly	Low (57): Use alternative system.*	
Tz: Tuttle	Percs slowly, slope, depth to rock.	Very low (23): Use alternative system.*	
Wb: Wabash	Flooding, wetness, percs slowly.	Very low (0): Use alternative system.***	
Wd: Wamego	Percs slowly, depth to rock.	Low (33): Use alternative system.*	

See footnotes at end of table.

TABLE 17.--SOIL POTENTIAL RATINGS FOR SEPTIC TANK ABSORPTION FIELDS--Continued

Soil name and map symbol	Limitations	Soil potential (index) and corrective treatment	Continuing limitations
We------------------ Wamego	Percs slowly, slope, depth to rock.	Very low (28): Use alternative system.*	
Wg------------------ Wann	Flooding, wetness.	Very low (0): Use alternative system.***	
Wk, Wm, Wn---------- Wymore	Percs slowly, wetness.	Low (33): Use alternative system.*	
Ws------------------ Wymore Variant	Percs slowly, wetness.	Low (33): Use alternative system.*	
Zo------------------ Zook	Flooding, percs slowly, wetness.	Very low (0): Use alternative system.*	

* Permeability is too slow for permit to be issued.
** See description of the map unit for composition and behavior characteristics of the map unit.
*** County regulation prohibits the location of a sewage system on a flood plain.

TABLE 18.--SOIL POTENTIAL RATINGS FOR SEWAGE LAGOON AREAS

(No lagoon system shall be constructed without prior authorization of the Kansas Department of Health and Environment)

Soil name and map symbol	Limitations	Soil potential (index) and corrective treatment	Continuing management needs
Bd: Benfield	Depth to rock, slope.	Medium (86): Line lagoon; level area.	Maintain liner.
Bf*:			
Benfield	Depth to rock.	Medium (86): Line lagoon.	Maintain liner.
Florence	Slope, large stones.	Medium (83): Line lagoon; level area.	Maintain liner.
Ce: Chase	Flooding, wetness.	High (91): Increase height of lagoon embankment; install interceptor tile around lagoon.	Maintain lagoon embankment.
Cm: Clime	Depth to rock, slope.	Low (75): Line lagoon; level area.	Maintain liner.
Cs*:			
Clime	Depth to rock, slope.	Low (78): Line lagoon; level area.	Maintain liner.
Sogn	Depth to rock, slope.	Low (66): Line lagoon; level area.	Maintain liner.
Em, Eo: Elmont	Depth to rock, slope.	Medium (86): Line lagoon; level area.	Maintain liner.
Eu: Eudora	Flooding. seepage.	Medium (82): Increase height of lagoon embankment; line lagoon.	Maintain liner and lagoon embankment.
Ex*:			
Eudora	Flooding, seepage.	Medium (82): Increase height of lagoon embankment; line lagoon.	Maintain liner and lagoon embankment.
Kimo	Flooding, seepage, wetness.	Low (66): Increase height of lagoon embankment; line lagoon; install interceptor tile around lagoon.	Maintain liner and lagoon embankment.
Gm: Gymer	Slope, seepage.	Very high (97): Level area; compact floor and walls of lagoon.	None.
Hn: Haynie	Flooding, seepage.	Very low (64): Install flood-control system; increase height of lagoon embankment; line lagoon.	Maintain liner, lagoon embankment, and flood-control system.
Hs*:			
Haynie	Flooding, seepage.	Very low (64): Install flood-control system; increase height of lagoon embankment; line lagoon.	Maintain liner, lagoon embankment, and flood-control system.

See footnote at end of table.

TABLE 18.--SOIL POTENTIAL RATINGS FOR SEWAGE LAGOON AREAS--Continued

Soil name and map symbol	Limitations	Soil potential (index) and corrective treatment	Continuing management needs
Hs*:			
Sarpy	Flooding, seepage.	Very low (47): Install flood-control system; increase height of lagoon embankment; use impervious material for lagoon embankment; line lagoon.	Maintain liner, lagoon embankment, and flood-control system.
Kc Kennebec	Flooding, seepage, wetness.	Very low (44): Install flood-control system; increase height of lagoon; install interceptor tile around lagoon.	Maintain liner, lagoon embankment, and flood-control system.
Kf Kennebec	Flooding, seepage, wetness.	Very low (62): Install flood-control system; increase height of lagoon embankment; line lagoon; install interceptor tile around lagoon.	Maintain liner, lagoon embankment, and flood-control system.
Km Kimo	Flooding, seepage, wetness.	Low (66): Increase height of lagoon embankment; line lagoon; install interceptor tile around lagoon.	Maintain liner and lagoon embankment.
Mm Monona	Slope, seepage.	Medium (86): Level area; line lagoon.	Maintain liner.
Mo, Mr Morrill	Slope, seepage.	Medium (86): Level area; line lagoon.	Maintain liner.
Mt Morrill	Slope, large stones, seepage.	Low (75): Level area; line lagoon.	Maintain liner.
Mu Muir	Flooding, seepage.	Medium (82): Increase height of lagoon embankment; line lagoon.	Maintain liner and lagoon embankment.
Op Ortello	Slope, seepage.	Medium (86): Level area; line lagoon.	Maintain liner.
Ot Ortello	Slope, seepage.	Low (80): Level area; line lagoon.	Maintain liner.
Pe Pawnee	Wetness	Very high (100): Install interceptor tile around lagoon.	None.
Pn, Po Pawnee	Slope, wetness.	High (95): Level area; install interceptor tile around lagoon.	None.
Ps Paxico	Flooding, seepage, wetness.	Very low (45): Install flood-control system; increase height of lagoon embankment; line lagoon; install interceptor tile around lagoon.	Maintain liner, lagoon embankment, and flood-control system.
Pt*. Pits			
Re Reading	Flooding	Medium (82): Increase height of lagoon embankment.	Maintain lagoon embankment.

See footnote at end of table.

TABLE 18.--SOIL POTENTIAL RATINGS FOR SEWAGE LAGOON AREAS--Continued

Soil name and map symbol	Limitations	Soil potential (index) and corrective treatment	Continuing management needs
Sf: Sarpy	Flooding, seepage.	Very low (47): Install flood-control system; increase height of lagoon embankment; use impervious material for lagoon embankment; line lagoon.	Maintain liner, lagoon embankment, and flood-control system.
Sg: Sharpsburg	Slope, seepage.	Medium (86): Level area; line lagoon.	Maintain liner.
Th: Thurman	Slope, seepage.	Very low (64): Level area; use impervious material for lagoon embankment; line lagoon.	Maintain liner and lagoon embankment.
Tu, Tx: Tully	Slope.	Very high (97): Level area.	None.
Tz: Tuttle	Slope, depth to rock.	Low (75): Level area; line lagoon.	Maintain liner.
Wb: Wabash	Flooding, wetness.	Very low (62): Install flood-control system; increase height of lagoon embankment; install interceptor tile around lagoon.	Maintain flood-control system and lagoon embankment.
Wd: Wamego	Slope, depth to rock.	Medium (86): Level area; line lagoon.	Maintain liner.
We: Wamego	Slope, depth to rock.	Low (80): Level area; line lagoon.	Maintain liner.
Wg: Wann	Flooding, seepage, wetness.	Very low (45): Install flood-control system; increase height of lagoon embankment; line lagoon; install interceptor tile around lagoon.	Maintain liner, lagoon embankment, and flood-control system.
Wk: Wymore	Wetness.	Very high (100): Install interceptor tile around lagoon.	None.
Wm, Wn: Wymore	Slope, wetness.	High (95): Level area; install interceptor tile around lagoon.	None.
Ws: Wymore Variant	Wetness.	Very high (100): Install interceptor tile around lagoon.	None.
Zo: Zook	Flooding, wetness.	Very low (62): Install flood-control system; increase height of lagoon embankment; install interceptor tile around lagoon.	Maintain lagoon embankment and flood-control system.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 19.--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	
Bd----------------- Benfield	0-6	Silty clay loam	CL	A-6, A-7	0-15	85-100	85-100	85-95	85-95	30-50	11-25
	6-30	Silty clay, silty clay loam, cherty silty clay.	CH, CL	A-7-6	0-15	85-100	70-100	70-95	70-95	40-60	20-35
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Bf*: Benfield--------	0-6	Silty clay loam	CL	A-6, A-7	0-15	85-100	85-100	85-95	85-95	30-50	11-25
	6-30	Silty clay, silty clay loam, cherty silty clay.	CH, CL	A-7-6	0-15	85-100	70-100	70-95	70-95	40-60	20-35
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Florence--------	0-14	Cherty silty clay loam.	GC, SC, CL	A-6, A-2-6	0-10	30-90	20-75	20-75	20-70	25-35	10-20
	14-42	Very cherty silty clay, very cherty clay, cherty clay.	GC, SC	A-2-7, A-7	10-20	30-70	20-45	20-45	15-40	50-65	30-40
	42	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Ce--------------- Chase	0-16	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-45	15-25
	16-48	Silty clay, silty clay loam, clay.	CH, CL	A-7, A-6	0	100	100	95-100	90-100	35-65	20-45
	48-60	Silty clay loam, silty clay.	CH, CL	A-7, A-6	0	100	100	95-100	90-100	35-60	20-40
Cm--------------- Clime	0-6	Silty clay loam	CL	A-6, A-7-6	0-5	90-100	90-100	85-100	80-95	35-50	15-25
	6-26	Silty clay, clay, silty clay loam.	CH, CL	A-7, A-6	0-10	85-100	75-100	75-95	75-95	35-60	15-35
	26	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Cs*: Clime-----------	0-8	Silty clay loam	CL	A-6, A-7-6	0-5	90-100	90-100	85-100	80-95	35-50	15-25
	8-26	Silty clay, clay, silty clay loam.	CH, CL	A-7, A-6	0-10	85-100	75-100	75-95	75-95	35-60	15-35
	26	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Sogn------------	0-14	Silty clay loam	CL, MH, CH, ML	A-6, A-7	0-10	85-100	85-100	85-100	70-100	25-55	10-25
	14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Em--------------- Elmont	0-10	Silty clay loam	CL	A-6	0	100	100	90-100	75-100	35-40	15-20
	10-50	Silty clay loam, clay loam.	CL	A-6, A-7-6	0	100	100	95-100	85-100	35-45	15-25
	50	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 19.--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	
Eo----------------- Elmont	0-5	Silty clay loam	CL	A-6	0	100	100	90-100	75-100	35-40	15-20
	5-47	Silty clay loam, clay loam.	CL	A-6, A-7-6	0	100	100	95-100	85-100	35-45	15-25
	47	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Eu----------------- Eudora	0-15	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	95-100	60-98	20-35	2-11
	15-60	Silt loam, very fine sandy loam, loam.	ML, CL, CL-ML	A-4	0	100	100	95-100	60-98	10-25	NP-10
Ex*:											
Eudora----------	0-15	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	95-100	60-98	20-35	2-11
	15-60	Silt loam, very fine sandy loam, loam.	ML, CL, CL-ML	A-4	0	100	100	95-100	60-98	10-25	NP-10
Kimo-------------	0-22	Silty clay loam	CH, CL	A-7-6	0	100	100	95-100	90-100	45-65	20-40
	22-60	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
Gm----------------- Gymer	0-11	Silty clay loam	CL, ML	A-4, A-6	0	100	100	95-100	75-100	25-40	8-20
	11-43	Silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	95-100	85-100	35-55	15-30
	43-60	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-100	30-45	11-25
Hn----------------- Haynie	0-9	Very fine sandy loam.	CL-ML, CL	A-4, A-6	0	100	100	85-100	70-100	25-40	5-15
	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
Hs*:											
Haynie----------	0-9	Very fine sandy loam.	CL-ML, CL	A-4, A-6	0	100	100	85-100	70-100	25-40	5-15
	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
Sarpy-----------	0-6	Fine sand--------	SM, SP-SM, SP	A-2-4, A-3	0	100	100	60-80	2-15	---	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
Kc, Kf----------- Kennebec	0-54	Silt loam--------	CL	A-6, A-7	0	100	100	95-100	90-100	25-45	10-20
	54-60	Silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	100	100	95-100	90-100	25-40	5-15
Km----------------- Kimo	0-22	Silty clay-------	CH, CL	A-7-6	0	100	100	95-100	90-100	45-65	20-40
	22-60	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
Mm----------------- Monona	0-14	Silt loam--------	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
	14-30	Silt loam, silty clay loam.	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
	30-60	Silt loam--------	CL	A-6	0	100	100	95-100	95-100	30-40	10-20

See footnote at end of table.

TABLE 19.--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	
Mo---------------- Morrill	0-13	Loam-------------	CL	A-4, A-6	0	95-100	80-100	70-100	50-80	25-40	7-20
	13-34	Clay loam, sandy clay loam, gravelly clay loam.	CL, SC	A-6, A-7-6	0	85-100	70-100	60-100	35-80	30-45	11-25
	34-60	Loam, clay loam, sandy loam.	CL, ML, SM, SC	A-4, A-6, A-2	0	90-100	70-100	60-100	30-80	20-35	2-15
Mr---------------- Morrill	0-6	Clay loam--------	CL	A-4, A-6	0	95-100	80-100	70-100	50-80	25-40	7-20
	6-30	Clay loam, sandy clay loam, gravelly clay loam.	CL, SC	A-6, A-7-6	0	85-100	70-100	60-100	35-80	30-45	11-25
	30-60	Loam, clay loam, sandy loam.	CL, ML, SM, SC	A-4, A-6, A-2	0	90-100	70-100	60-100	30-80	20-35	2-15
Mt---------------- Morrill	0-10	Loam-------------	CL	A-4, A-6	0	95-100	80-100	70-100	50-80	25-40	7-20
	10-41	Clay loam, sandy clay loam, gravelly clay loam.	CL, SC	A-6, A-7-6	0	85-100	70-100	60-100	35-80	30-45	11-25
	41-60	Loam, clay loam, sandy loam.	CL, ML, SM, SC	A-4, A-6, A-2	0	90-100	70-100	60-100	30-80	20-35	2-15
Mu---------------- Muir	0-44	Silt loam--------	CL, ML, CL-ML	A-4, A-6	0	100	100	95-100	85-100	20-35	4-15
	44-60	Silt loam, silty clay loam.	CL, ML, CL-ML	A-4, A-6, A-7-6	0	100	100	95-100	85-100	20-45	4-20
Op, Ot----------- Ortello	0-19	Fine sandy loam	SM, ML	A-4	0	100	100	70-95	40-55	<20	NP
	19-27	Fine sandy loam, sandy loam.	SM, ML	A-4	0	100	100	70-95	40-55	<20	NP
	27-60	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM	A-3, A-2	0	100	100	50-70	5-35	---	NP
Pe, Pn----------- Pawnee	0-15	Clay loam--------	CL	A-6	0	95-100	95-100	85-100	70-90	30-40	10-20
	15-42	Clay-------------	CH	A-7	0	95-100	95-100	85-100	70-85	50-70	25-45
	42-60	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-------------	CH	A-7	0	95-100	95-100	85-100	70-85	50-70	25-45
	6-38	Clay-------------	CH	A-7	0	95-100	95-100	85-100	70-85	50-70	25-45
	38-60	Clay loam, sandy clay loam.	CL, CH	A-7, A-6	0	95-100	95-100	80-100	70-90	35-55	20-40
Ps---------------- Paxico	0-42	Silt loam--------	ML, CL-ML, CL	A-4	0	100	100	85-100	75-90	15-30	NP-10
	42-60	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
Pt*. Pits											

See footnote at end of table.

TABLE 19.--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	
Re---------------- Reading	0-20	Silty clay loam	CL	A-6	0	100	100	90-100	85-100	35-40	15-20
	20-53	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	15-30
	53-60	Silty clay loam, clay loam, silty clay.	CL	A-6, A-7	0	100	100	95-100	80-100	35-50	15-30
Sf---------------- Sarpy	0-6	Sand-------------	SM, SP-SM, SP	A-2-4, A-3	0	100	100	60-80	2-15	---	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
Sg---------------- Sharpsburg	0-7	Silt loam--------	CL	A-6	0	100	100	100	95-100	25-40	10-20
	7-18	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-60	20-35
	18-44	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
	44-60	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
Th---------------- Thurman	0-17	Loamy fine sand	SM, SP-SM	A-2, A-3, A-4	0	100	100	90-100	5-40	<20	NP
	17-60	Loamy fine sand, fine sand, loamy sand.	SM, SP-SM	A-2, A-3	0	100	100	85-100	5-25	---	NP
Tu---------------- Tully	0-13	Silty clay loam	CL, ML, MH, CH	A-6, A-7	0	100	75-100	75-100	70-95	35-55	10-25
	13-42	Silty clay, silty clay loam, cherty silty clay.	CH, CL	A-7	0	90-100	70-100	65-100	55-95	40-65	20-40
	42-60	Silty clay, clay, cherty silty clay.	CH, CL, SC	A-7	0	90-100	50-100	45-100	35-100	40-65	20-40
Tx---------------- Tully	0-4	Silty clay-------	CL, ML, MH, CH	A-6, A-7	0	100	75-100	75-100	70-95	35-55	10-25
	4-60	Silty clay, silty clay loam, cherty silty clay.	CH, CL	A-7	0	90-100	70-100	65-100	55-95	40-65	20-40
Tz---------------- Tuttle	0-15	Channery silty clay loam.	CL	A-6, A-7-6	5-35	85-100	80-100	80-100	75-95	35-50	15-25
	15-24	Channery silty clay loam, channery clay loam.	CL	A-6, A-7-6	0-35	85-100	80-100	80-100	75-95	35-50	15-25
	24-46	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
	46	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Wb---------------- Wabash	0-18	Silty clay-------	CH	A-7	0	100	100	100	95-100	50-75	30-50
	18-60	Silty clay, clay	CH	A-7	0	100	100	100	95-100	52-78	30-55

See footnote at end of table.

TABLE 19.--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	
Wd, We----------- Wamego	0-10	Silt loam--------	CL	A-6	0	100	100	90-100	60-95	30-40	10-20
	10-27	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
	27	Weathered bedrock	---	---	---	---	---	---	---	---	---
Wg--------------- Wann	0-11	Fine sandy loam	SM, SM-SC	A-2, A-4	0	95-100	95-100	70-100	30-50	<25	NP-5
	11-45	Sandy loam, fine sandy loam.	SM, SM-SC	A-2, A-4	0	95-100	75-100	60-100	20-50	<25	NP-5
	45-60	Stratified sandy clay loam to fine sand.	SM	A-2, A-4	0	95-100	95-100	70-100	15-40	<20	NP-3
Wk, Wm, Wn------- Wymore	0-10	Silty clay loam	CL, CH, ML, MH	A-6, A-7	0	100	100	95-100	95-100	35-55	11-25
	10-35	Silty clay-------	CH	A-7	0	100	100	95-100	95-100	55-70	30-42
	35-60	Silty clay loam	CL, CH	A-6, A-7	0	100	100	95-100	85-100	35-55	20-35
Ws--------------- Wymore Variant	0-17	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4	0	100	100	70-95	45-70	<20	NP-5
	17-42	Silty clay-------	CH	A-7	0	100	100	95-100	95-100	55-70	30-40
	42-60	Silty clay loam	CL, CH	A-6, A-7	0	100	100	95-100	85-100	35-55	20-35
Zo--------------- Zook	0-8	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	45-65	20-35
	8-60	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 20.--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 K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Bd---------------- Benfield	0-6	27-35	1.30-1.40	0.2-2.0	0.21-0.24	6.1-7.8	<2	Moderate	0.37	3	7	1-4
	6-30	35-45	1.35-1.45	0.06-0.2	0.18-0.22	6.6-8.4	<2	High------	0.37			
	30	---	---	---	---	---	---	----------	----			
Bf*:												
Benfield---------	0-6	27-35	1.30-1.40	0.2-2.0	0.21-0.24	6.1-7.8	<2	Moderate	0.37	3	7	1-4
	6-30	35-45	1.35-1.45	0.06-0.2	0.18-0.22	6.6-8.4	<2	High------	0.37			
	30	---	---	---	---	---	---	----------	----			
Florence---------	0-14	27-35	1.25-1.35	0.6-2.0	0.05-0.20	5.6-7.3	<2	Low-------	0.24	3	8	2-4
	14-42	40-55	1.35-1.55	0.2-0.6	0.03-0.11	6.1-7.8	<2	Moderate	0.24			
	42	---	---	---	---	---	---	----------	----			
Ce---------------- Chase	0-16	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
	16-48	35-55	1.35-1.45	0.06-0.2	0.11-0.19	5.6-7.8	<2	High------	0.28			
	48-60	27-50	1.35-1.45	0.06-0.2	0.11-0.18	6.1-8.4	<2	High------	0.28			
Cm---------------- Clime	0-6	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
	6-26	35-60	1.35-1.50	0.06-0.2	0.12-0.18	7.4-8.4	<2	Moderate	0.28			
	26	---	---	---	---	---	---	----------	----			
Cs*:												
Clime------------	0-8	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
	8-26	35-60	1.35-1.50	0.06-0.2	0.12-0.18	7.4-8.4	<2	Moderate	0.28			
	26	---	---	---	---	---	---	----------	----			
Sogn-------------	0-14	27-35	1.15-1.20	0.6-2.0	0.17-0.22	6.1-8.4	<2	Moderate	0.32	1	4L	---
	14	---	---	---	---	---	---	----------	----			
Em---------------- Elmont	0-10	27-33	1.30-1.40	0.2-0.6	0.18-0.23	5.1-7.3	<2	Moderate	0.32	5	7	2-4
	10-50	27-35	1.30-1.45	0.2-0.6	0.18-0.20	5.1-7.3	<2	Moderate	0.43			
	50	---	---	---	---	---	---	----------	----			
Eo---------------- Elmont	0-5	27-33	1.30-1.40	0.2-0.6	0.18-0.23	5.1-7.3	<2	Moderate	0.32	5	7	2-4
	5-47	27-35	1.30-1.45	0.2-0.6	0.18-0.20	5.1-7.3	<2	Moderate	0.43			
	47	---	---	---	---	---	---	----------	----			
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	5	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-----------	0-15	5-18	1.30-1.50	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low-------	0.32	5	5	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			
Kimo-------------	0-22	35-50	1.20-1.30	0.06-0.2	0.13-0.22	6.1-8.4	<2	High------	0.37	5	7	2-4
	22-60	7-18	1.30-1.40	0.6-2.0	0.17-0.22	6.1-8.4	<2	Low-------	0.37			
Gm---------------- 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
	11-43	35-42	1.40-1.50	0.2-0.6	0.12-0.20	5.6-6.5	<2	Moderate	0.43			
	43-60	27-35	1.30-1.40	0.6-2.0	0.18-0.20	5.6-6.5	<2	Moderate	0.43			
Hn---------------- Haynie	0-9	15-20	1.20-1.35	0.6-2.0	0.18-0.23	7.4-8.4	<2	Low-------	0.37	5	4L	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 20.--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
Hs*:												
Haynie----------	0-9	15-20	1.20-1.35	0.6-2.0	0.18-0.23	7.4-8.4	<2	Low--------	0.37	5	4L	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			
Sarpy-----------	0-6	2-5	1.20-1.50	>6.0	0.05-0.09	6.6-8.4	<2	Low--------	0.15	5	1	<1
	6-60	2-5	1.20-1.50	>6.0	0.05-0.09	6.6-8.4	<2	Low--------	0.15			
Kc, Kf----------- Kennebec	0-54	22-27	1.25-1.35	0.6-2.0	0.22-0.24	5.6-7.3	<2	Moderate	0.32	5	6	5-6
	54-60	24-28	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	<2	Moderate	0.43			
Km--------------- Kimo	0-22	40-50	1.20-1.30	0.06-0.2	0.13-0.22	6.1-8.4	<2	High------	0.37	5	7	2-4
	22-60	7-18	1.30-1.40	0.6-2.0	0.17-0.22	6.1-8.4	<2	Low--------	0.37			
Mm--------------- Monona	0-14	20-27	1.25-1.30	0.6-2.0	0.22-0.24	5.6-7.3	<2	Moderate	0.32	5	6	3-4
	14-30	24-28	1.30-1.35	0.6-2.0	0.20-0.22	6.1-7.3	<2	Moderate	0.43			
	30-60	18-24	1.35-1.40	0.6-2.0	0.20-0.22	6.6-8.4	<2	Moderate	0.43			
Mo--------------- Morrill	0-13	15-29	1.30-1.40	0.6-2.0	0.14-0.21	5.1-7.3	<2	Low--------	0.28	5	6	1-4
	13-34	25-35	1.35-1.45	0.6-2.0	0.15-0.19	5.1-7.3	<2	Moderate	0.28			
	34-60	10-29	1.40-1.55	0.6-2.0	0.15-0.18	5.1-7.3	<2	Low--------	0.37			
Mr--------------- Morrill	0-6	15-27	1.30-1.40	0.6-2.0	0.14-0.21	5.1-7.3	<2	Low--------	0.28	5	6	<1
	6-30	25-35	1.35-1.45	0.6-2.0	0.15-0.19	5.1-7.3	<2	Moderate	0.28			
	30-60	10-29	1.40-1.55	0.6-2.0	0.15-0.18	5.1-7.3	<2	Low--------	0.37			
Mt--------------- Morrill	0-10	27-29	1.30-1.40	0.6-2.0	0.14-0.21	5.1-7.3	<2	Low--------	0.28	5	6	1-4
	10-41	25-35	1.35-1.45	0.6-2.0	0.15-0.19	5.1-7.3	<2	Moderate	0.28			
	41-60	10-29	1.40-1.55	0.6-2.0	0.15-0.18	5.1-7.3	<2	Low--------	0.37			
Mu--------------- Muir	0-44	18-27	1.30-1.45	0.6-2.0	0.20-0.23	5.6-7.8	<2	Low--------	0.32	5	6	2-4
	44-60	18-35	1.30-1.50	0.6-2.0	0.18-0.22	6.1-8.4	<2	Low--------	0.32			
Op, Ot----------- Ortello	0-19	5-15	1.40-1.60	2.0-6.0	0.13-0.18	6.1-7.3	<2	Low--------	0.20	5	3	1-2
	19-27	5-15	1.40-1.60	2.0-6.0	0.12-0.17	6.1-7.3	<2	Low--------	0.20			
	27-60	2-10	1.50-1.70	6.0-20	0.05-0.10	6.6-7.8	<2	Low--------	0.15			
Pe, Pn----------- Pawnee	0-15	30-38	1.40-1.50	0.2-0.6	0.17-0.19	5.6-7.3	<2	Moderate	0.37	4	6	3-4
	15-42	40-50	1.50-1.70	0.06-0.2	0.09-0.11	6.1-8.4	<2	High------	0.37			
	42-60	25-35	1.40-1.50	0.06-0.2	0.14-0.16	7.4-8.4	<2	High------	0.37			
Po--------------- Pawnee	0-6	40-46	1.40-1.50	0.06-0.2	0.09-0.11	5.6-7.3	<2	High------	0.37	3	4	<1
	6-38	40-50	1.50-1.70	0.06-0.2	0.09-0.11	6.1-8.4	<2	High------	0.37			
	38-60	25-35	1.40-1.50	0.06-0.2	0.14-0.16	7.4-8.4	<2	High------	0.37			
Ps--------------- Paxico	0-42	5-18	1.20-1.50	0.6-2.0	0.15-0.23	6.6-8.4	<2	Low--------	0.37	5	3	1-3
	42-60	2-15	1.40-1.60	2.0-6.0	0.10-0.17	7.4-8.4	<2	Low--------	0.17			
Pt*. Pits												
Re--------------- Reading	0-20	27-30	1.35-1.40	0.6-2.0	0.21-0.23	5.6-7.3	<2	Moderate	0.32	5	6	2-4
	20-53	27-35	1.40-1.50	0.2-0.6	0.18-0.20	5.6-7.3	<2	Moderate	0.43			
	53-60	30-42	1.40-1.50	0.2-0.6	0.13-0.20	6.1-8.4	<2	Moderate	0.43			
Sf--------------- Sarpy	0-6	2-5	1.20-1.50	6.0-20	0.05-0.09	6.6-8.4	<2	Low--------	0.15	5	1	<1
	6-60	2-5	1.20-1.50	6.0-20	0.05-0.09	7.4-8.4	<2	Low--------	0.15			

See footnote at end of table.

TABLE 20.--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
Sg---------------	0-7	25-27	1.30-1.35	0.6-2.0	0.21-0.23	5.1-6.5	<2	Moderate	0.32	5	6	3-4
Sharpsburg	7-18	36-42	1.35-1.40	0.2-0.6	0.18-0.20	5.1-6.0	<2	Moderate	0.43			
	18-44	30-38	1.40-1.45	0.6-2.0	0.18-0.20	5.1-6.5	<2	Moderate	0.43			
	44-60	25-32	1.40-1.45	0.6-2.0	0.18-0.20	6.1-6.5	<2	Moderate	0.43			
Th---------------	0-17	5-12	1.60-1.80	6.0-20	0.10-0.12	6.1-7.3	<2	Low--------	0.17	5	2	1-2
Thurman	17-60	2-10	1.60-1.80	6.0-20	0.06-0.11	6.1-7.3	<2	Low--------	0.17			
Tu---------------	0-13	28-38	1.35-1.45	0.2-2.0	0.18-0.23	5.6-7.3	<2	Moderate	0.37	4	7	2-4
Tully	13-42	35-55	1.40-1.50	0.06-0.2	0.10-0.15	5.6-7.8	<2	High-------	0.37			
	42-60	35-55	1.40-1.50	0.06-0.2	0.07-0.15	6.6-8.4	<2	High-------	0.37			
Tx---------------	0-4	40-45	1.35-1.45	0.2-2.0	0.18-0.23	5.6-7.3	<2	Moderate	0.37	4	7	1-3
Tully	4-60	35-55	1.40-1.50	0.06-0.2	0.10-0.15	5.6-7.8	<2	High-------	0.37			
Tz---------------	0-15	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
Tuttle	15-24	35-45	1.35-1.45	0.2-0.6	0.10-0.18	7.9-8.4	<2	Moderate	0.20			
	24-46	35-50	1.35-1.50	0.06-0.2	0.10-0.14	7.9-8.4	<2	Moderate	0.20			
	46	---	---	---	---	---	---	----------	----			
Wb---------------	0-18	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
Wabash	18-60	40-60	1.20-1.45	<0.06	0.08-0.12	5.6-7.8	<2	Very high	0.28			
Wd, We-----------	0-10	24-27	1.30-1.50	0.6-2.0	0.21-0.24	5.6-6.5	<2	Low--------	0.32	4	6	2-4
Wamego	10-27	35-42	1.50-1.70	0.06-0.2	0.12-0.20	5.6-7.3	<2	Moderate	0.43			
	27	---	---	---	---	---	---	----------	----			
Wg---------------	0-11	5-15	1.70-1.90	2.0-6.0	0.13-0.18	6.6-8.4	<2	Low--------	0.20	5	3	1-3
Wann	11-45	3-18	1.70-1.90	2.0-6.0	0.11-0.17	7.4-8.4	<2	Low--------	0.20			
	45-60	3-22	1.40-1.60	2.0-6.0	0.09-0.12	7.4-8.4	<2	Low--------	0.15			
Wk, Wm, Wn-------	0-10	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
Wymore	10-35	42-55	1.10-1.20	0.06-0.2	0.11-0.14	5.6-7.3	<2	High-------	0.37			
	35-60	27-40	1.15-1.25	0.2-0.6	0.18-0.20	6.6-7.3	<2	High-------	0.37			
Ws---------------	0-17	5-15	1.30-1.50	2.0-6.0	0.13-0.18	6.1-7.3	<2	Low--------	0.28	5	3	1-2
Wymore Variant	17-42	42-55	1.10-1.20	0.06-0.2	0.11-0.14	5.6-7.3	<2	High-------	0.37			
	42-60	27-40	1.15-1.25	0.2-0.6	0.18-0.20	6.6-7.3	<2	High-------	0.37			
Zo---------------	0-8	32-38	1.30-1.35	0.2-0.6	0.21-0.23	5.6-7.3	<2	High-------	0.28	5	7	5-7
Zook	8-60	36-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.8	<2	High-------	0.28			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 21.--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				
Bd----------------- Benfield	C	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	High------	Low.
Bf*:												
Benfield----------	C	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	High------	Low.
Florence----------	C	None---------	---	---	>6.0	---	---	40-60	Hard	Moderate	Moderate	Low.
Ce----------------- Chase	C	Rare---------	---	---	2.0-4.0	Perched	Feb-May	>60	---	High------	High------	Low.
Cm----------------- 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.
Em, 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.
Gm----------------- Gymer	C	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.

See footnote at end of table.

TABLE 21.--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				
Hn------------------ Haynie	B	Occasional	Very brief	Feb-Nov	>6.0	---	---	>60	---	High-----	Low------	Low.
Hs*:												
Haynie------------	B	Occasional	Very brief	Feb-Nov	>6.0	---	---	>60	---	High-----	Low------	Low.
Sarpy-------------	A	Occasional	Brief to long.	Nov-Jun	>6.0	---	---	>60	---	Low------	Low------	Low.
Kc------------------ Kennebec	B	Frequent----	Brief------	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	>60	---	High-----	Moderate	Low.
Kf------------------ Kennebec	B	Occasional	Brief------	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	>60	---	High-----	Moderate	Low.
Km------------------ Kimo	C	Rare--------	---	---	2.0-6.0	Apparent	Mar-Jun	>60	---	High-----	High-----	Low.
Mm------------------ Monona	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low------	Low.
Mo, Mr, Mt-------- Morrill	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
Mu------------------ Muir	B	Rare--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
Op, Ot------------- Ortello	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Pe, Pn, Po-------- Pawnee	D	None--------	---	---	1.0-3.0	Perched	Mar-May	>60	---	High-----	High-----	Low.
Ps------------------ Paxico	B	Frequent----	Brief to long.	Nov-Jun	1.5-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Low.
Pt*. Pits												

See footnote at end of table.

TABLE 21.--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				
Re----------------- Reading	B	Rare---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Low.
Sf----------------- Sarpy	A	Frequent----	Brief to long.	Nov-Jun	>6.0	---	---	>60	---	Low------	Low------	Low.
Sg----------------- Sharpsburg	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
Th----------------- Thurman	A	None---------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
Tu, Tx------------- Tully	C	None---------	---	---	>6.0	---	---	>60	---	Moderate	High-----	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.
Wd, We------------- Wamego	C	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate	Moderate.
Wg----------------- Wann	B	Frequent----	Brief-----	Mar-Nov	1.5-3.5	Apparent	Mar-Jul	>60	---	High-----	Moderate	Low.
Wk, Wm, Wn--------- Wymore	D	None---------	---	---	1.0-3.0	Perched	Mar-Apr	>60	---	High-----	High-----	Moderate.
Ws----------------- Wymore Variant	C	None---------	---	---	1.0-3.0	Perched	Mar-Apr	>60	---	Moderate	High-----	Moderate.
Zo----------------- Zook	C/D	Occasional	Brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 22.--ENGINEERING INDEX TEST DATA

(LL means liquid limit; PI, plasticity index; MD, maximum dry density; and OM, optimum moisture)

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution							LL	PI	Moisture density	
			Percentage passing sieve--				Percentage smaller than--					MD	OM
	AASHTO	Unified	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm				
										Pct		Lb/ft3	Pct
Benfield silty clay loam:													
(S82KS-149-073)													
A----- 0 to 6	A-7	CH	100	100	99	95	71	46	38	51	22	88	26
Bt1--- 10 to 18	A-7	CL	100	100	98	92	74	48	39	49	24	96	23
Cr---- 30 to 52	A-4	CL	100	100	99	96	79	24	12	29	6	104	17
Chase silty clay loam:													
(S82KS-149-074)													
Ap---- 0 to 7	A-6	CL	100	100	100	98	64	27	18	35	12	99	17
Bt---- 21 to 43	A-7	CL	100	100	100	98	79	45	39	46	21	95	21
C----- 34 to 60	A-7	CL	100	100	100	98	75	40	34	42	18	98	19
Morrill loam:													
(S82KS-149-071)													
A----- 0 to 10	A-6	CL	100	100	99	69	40	20	14	36	15	101	17
Bt---- 13 to 24	A-6	CL	100	100	99	73	49	34	30	37	14	99	18
C----- 34 to 60	A-6	CL	100	100	99	60	32	23	20	28	11	109	15
Wamego silt loam:													
(S82KS-149-072)													
A----- 0 to 6	A-7	ML	100	100	95	76	49	25	13	41	14	95	20
Bt1--- 10 to 17	A-7	CL	100	100	96	84	61	37	23	41	16	101	18
Cr---- 17 to 24	A-7	CL	100	100	98	89	66	33	22	41	17	106	18

TABLE 23.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Benfield	Fine, mixed, mesic Udic Argiustolls
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
Kennebec	Fine-silty, mixed, mesic Cumulic Hapludolls
Kimo	Clayey over loamy, montmorillonitic, mesic Aquic Hapludolls
Monona	Fine-silty, mixed, mesic Typic Hapludolls
Morrill	Fine-loamy, mixed, mesic Typic Argiudolls
Muir	Fine-silty, mixed, mesic Cumulic Haplustolls
Ortello	Coarse-loamy, mixed, mesic Udic Haplustolls
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
Sharpsburg	Fine, montmorillonitic, mesic Typic Argiudolls
Sogn	Loamy, mixed, mesic Lithic Haplustolls
Thurman	Sandy, mixed, mesic Udorthentic Haplustolls
Tully	Fine, mixed, mesic Pachic Argiustolls
Tuttle	Fine, mixed, mesic Entic Haplustolls
Wabash	Fine, montmorillonitic, mesic Vertic Haplaquolls
Wamego	Fine, mixed, mesic Typic Argiudolls
Wann	Coarse-loamy, mixed, mesic Fluvaquentic Haplustolls
Wymore	Fine, montmorillonitic, mesic Aquic Argiudolls
Wymore Variant	Fine, montmorillonic, mesic Aquic Argiudolls
Zook	Fine, montmorillonitic, mesic Cumulic Haplaquolls

Interpretive Groups

INTERPRETIVE GROUPS

Map symbol	Map unit	Land capability*	Prime farmland*	Range site
Bd	Benfield silty clay loam, 2 to 5 percent slopes	IIIe	Yes	Loamy Upland.
Bf	Benfield-Florence complex, 3 to 15 percent slopes	VIe	No	
	Benfield			Loamy Upland.
	Florence			Loamy Upland.
Ce	Chase silty clay loam	IIw	Yes	Loamy Lowland.
Cm	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.
Em	Elmont silty clay loam, 3 to 7 percent slopes	IIIe	Yes	Loamy Upland.
Eo	Elmont silty clay loam, 3 to 7 percent slopes, eroded	IIIe	Yes	Loamy Upland.
Eu	Eudora silt loam	I	Yes	Loamy Lowland.
Ex	Eudora-Kimo complex	IIw	Yes	
	Eudora			Loamy Lowland.
	Kimo			Clay Lowland.
Gm	Gymer silty clay loam, 3 to 8 percent slopes	IIIe	Yes	Loamy Upland.
Hn	Haynie very fine sandy loam, occasionally flooded	IIw	Yes	Loamy Lowland.
Hs	Haynie-Sarpy complex, occasionally flooded	IIIw	No	
	Haynie			Loamy Lowland.
	Sarpy			Sandy Lowland.
Kc	Kennebec silt loam, channeled	Vw	No	Loamy Lowland.
Kf	Kennebec silt loam, occasionally flooded	IIw	Yes	Loamy Lowland.
Km	Kimo silty clay	IIw	Yes	Clay Lowland.
Mm	Monona silt loam, 5 to 10 percent slopes	IIIe	No	Loamy Upland.
Mo	Morrill loam, 3 to 7 percent slopes	IIIe	Yes	Loamy Upland.
Mr	Morrill clay loam, 3 to 7 percent slopes, eroded	IIIe	Yes	Loamy Upland.
Mt	Morrill loam, 5 to 20 percent slopes, stony	VIe	No	Loamy Upland.
Mu	Muir silt loam	I	Yes	Loamy Lowland.
Op	Ortello fine sandy loam, 3 to 7 percent slopes	IIIe	Yes	Sandy.
Ot	Ortello fine sandy loam, 7 to 12 percent slopes	IVe	No	Sandy.
Pe	Pawnee clay loam, 1 to 3 percent slopes	IIe	Yes	Clay Upland.
Pn	Pawnee clay loam, 3 to 6 percent slopes	IIIe	No	Clay Upland.
Po	Pawnee clay, 3 to 6 percent slopes, eroded	IVe	No	Clay Upland.
Ps	Paxico silt loam, frequently flooded	Vw	No	---
Pt	Pits, quarries.			

See footnotes at end of table

INTERPRETIVE GROUPS--Continued

Map symbol	Map unit	Land capability*	Prime farmland*	Range site
Re	Reading silty clay loam	I	Yes	Loamy Lowland.
Sf	Sarpy sand, frequently flooded	IVs	No	Sandy Lowland.
Sg	Sharpsburg silt loam, 1 to 4 percent slopes	IIe	Yes	Loamy Upland.
Th	Thurman loamy fine sand, 3 to 8 percent slopes	IVe	No	Sands.
Tu	Tully silty clay loam, 3 to 7 percent slopes	IIIe	Yes	Loamy Upland.
Tx	Tully silty clay loam, 3 to 7 percent slopes, eroded	IVe	No	Loamy Upland.
Tz	Tuttle channery silty clay loam, 20 to 40 percent slopes, stony	VIIe	No	---
Wb	Wabash silty clay, occasionally flooded	IIIw	Yes**	Clay Lowland.
Wd	Wamego silt loam, 3 to 7 percent slopes	IVe	No	Loamy Upland.
We	Wamego silt loam, 7 to 20 percent slopes	VIe	No	Loamy Upland.
Wg	Wann fine sandy loam, channeled	Vw	No	Subirrigated.
Wk	Wymore silty clay loam, 0 to 1 percent slopes	IIs	Yes	Clay Upland.
Wm	Wymore silty clay loam, 1 to 4 percent slopes	IIe	Yes	Clay Upland.
Wn	Wymore silty clay loam, 4 to 7 percent slopes	IIIe	Yes	Clay Upland.
Ws	Wymore Variant fine sandy loam, 1 to 3 percent slopes	IIe	Yes	Loamy Upland.
Zo	Zook silty clay loam, occasionally flooded	IIw	Yes**	Clay Lowland.

* A soil complex is treated as a single management unit in the land capability classification and prime farmland columns.
** Where drained.

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