United States
Department of
Agriculture

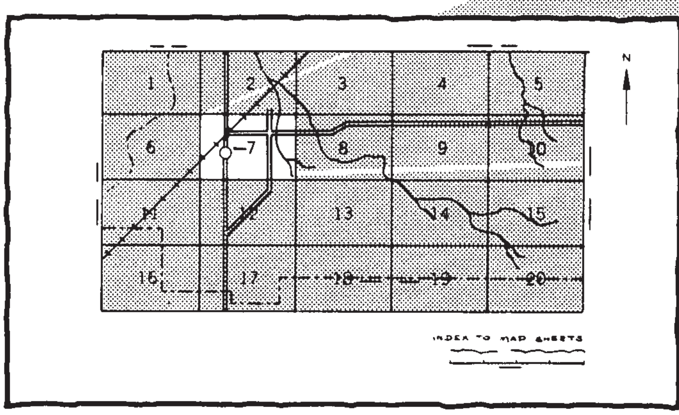
Soil
Conservation
Service

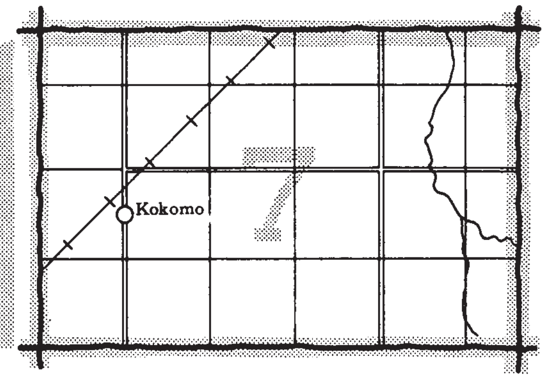
In cooperation with
Missouri Agricultural
Experiment Station

Soil Survey of Clay and Ray Counties, Missouri

HOW TO USE

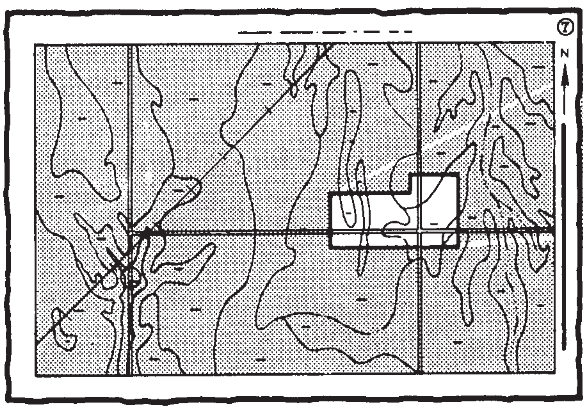
1. Locate your area of interest on the "Index to Map Sheets"

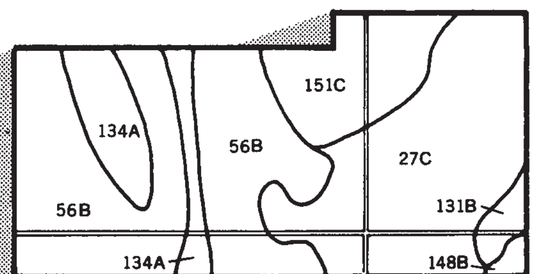




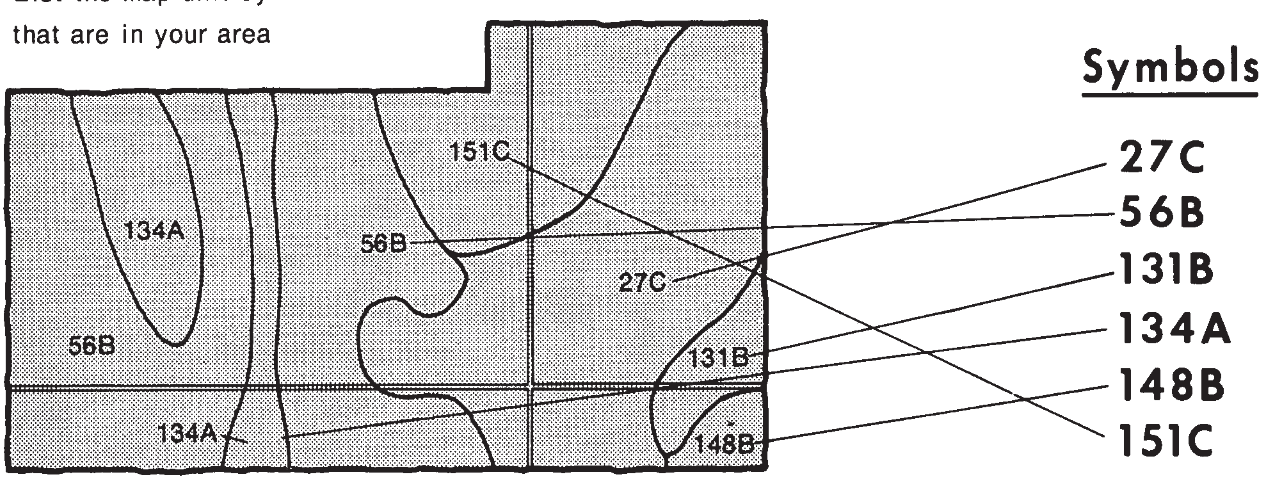
2. Note the number of the map sheet and turn to that sheet.

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



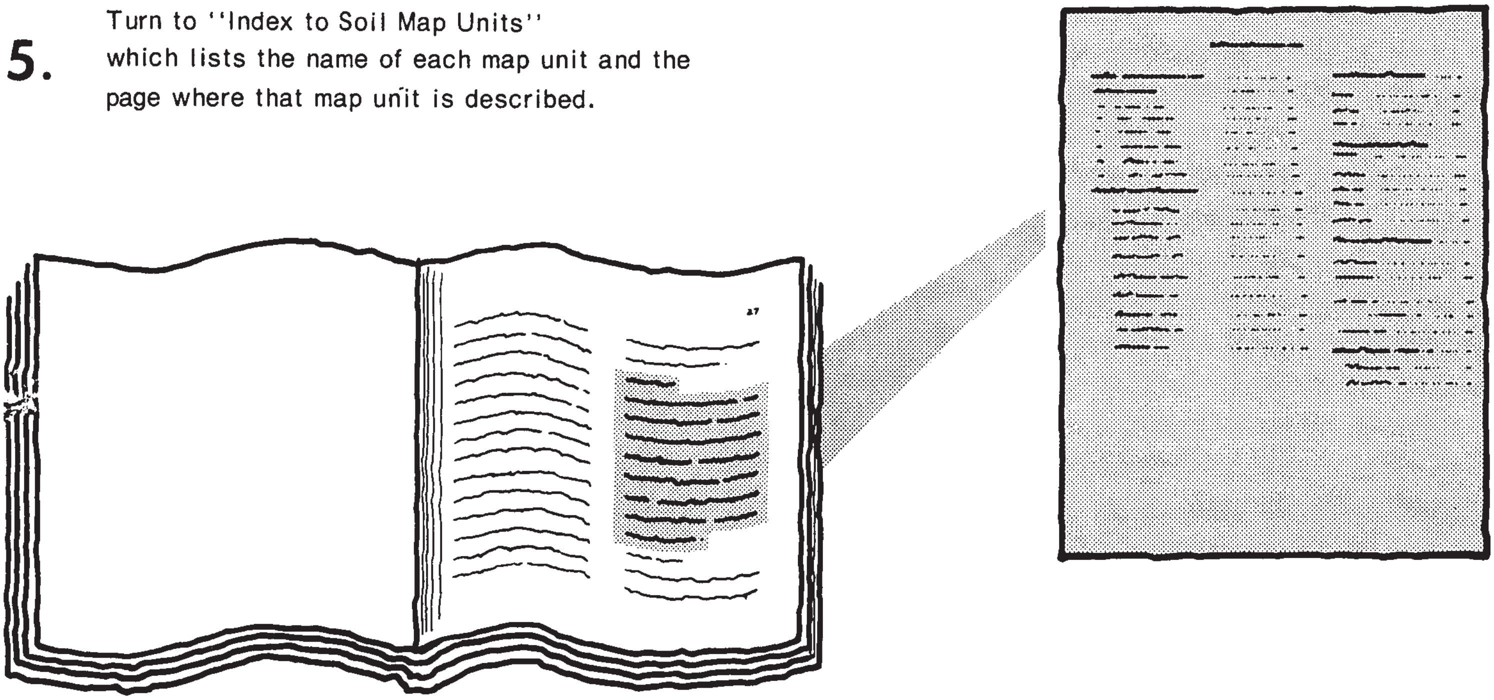


4. List the map unit symbols that are in your area

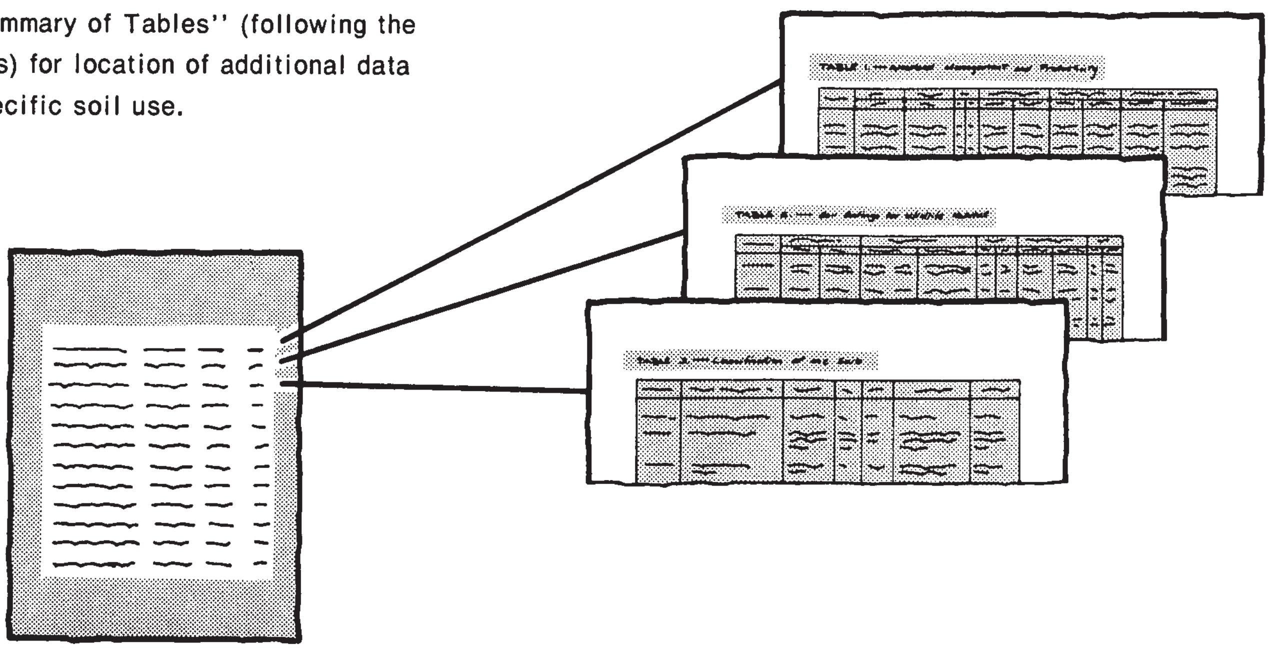


THIS SOIL SURVEY

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; for specialists in wildlife management, waste disposal, or pollution control.

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

Major fieldwork for this soil survey was completed during the period 1973-81. Soil names and descriptions were approved in 1982. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1982. This survey was made cooperatively by the Soil Conservation Service and the Missouri Agricultural Experiment Station. It is part of the technical assistance furnished to the Clay and Ray Counties Soil and Water Conservation Districts.

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

Cover: An area of bottom land along the Missouri River. The bottom land along the river is an important part of the agriculture in Clay and Ray Counties.

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Soil Series

Issued January 1986

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Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Clay and Ray Counties. 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, 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.

Paul F. Larson
State Conservationist
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Soil Survey of
Clay and Ray Counties, Missouri

By George D. Preston, Soil Conservation Service

Fieldwork by George D. Preston, Michael A. Cook, Richard E. McBee, and Leslie W. Tobin, Soil Conservation Service

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

Clay and Ray Counties are in the northwestern part of Missouri (fig. 1). They border the Missouri River on the south. They have a total area of about 628,665 acres, or 995 square miles. Liberty is the county seat of Clay County, and Richmond is the county seat of Ray County. Both of these towns are in the south-central parts of their respective counties. In 1980, Clay County had a population of 137,000 and Ray County had one of 21,434. Liberty had a population of 16,500; Gladstone, the largest city in Clay County, had one of 30,783; and Richmond had one of 5,499.

Both counties are in the Central Feed Grains and Livestock Region of the United States. Clay County and most of Ray County are in the Iowa and Missouri Deep Loess Hills land resource area. The northern part of Ray County is in the Iowa and Missouri Heavy Till Plain land resource area (*3*).

Farming is the main enterprise in Ray County. Soybeans, corn, and wheat are the major crops, and beef cattle and hogs are the principal livestock. While farming is still an important enterprise in Clay County, commerce and industry are now the major source of income. Large areas of Clay County and a small part of western Ray County have been subdivided for housing development or sold in 3- to 10-acre tracts. Generally, these areas are the better agricultural land. After this land is taken out of production, marginal agricultural land generally is brought into production.

This survey updates the soil survey of Ray County published in 1927 (*14*). It provides additional information and larger maps, which show the soils in greater detail.

Figure 1.—Location of Clay and Ray Counties in Missouri.

General Nature of the Survey Area

This section gives general information concerning the counties. It describes climate; history and development; physiography, relief, and drainage; and water supply.

Climate

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

The consistent pattern of climate in the survey area is one of cold winters and long, hot summers. Heavy rains occur mainly in spring and early in summer, when moist air from the Gulf of Mexico interacts with drier continental air. The annual rainfall normally is adequate for corn, soybeans, and all grain crops.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Kansas City, Missouri, in the period 1951 to 1979. 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 33 degrees F, and the average daily minimum temperature is 24 degrees. The lowest temperature on record, which occurred at Kansas City on January 23, 1963, is minus 9 degrees. In summer the average temperature is 78 degrees, and the average daily maximum temperature is 88 degrees. The highest recorded temperature, which occurred at Kansas City on July 13, 1954, is 112 degrees.

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

The total annual precipitation is about 36 inches. Of this, 25 inches, or 70 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 18 inches. The heaviest 1-day rainfall during the period of record was 7.45 inches at Kansas City on August 15, 1969. Thunderstorms occur on about 53 days each year, and most occur in summer.

The average seasonal snowfall is about 22 inches. The greatest snow depth at any one time during the period of record was 21 inches. On the average, 8 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 average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 75 percent of the time possible in summer and 60 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 12 miles per hour, in spring. Tornadoes and severe thunderstorms strike occasionally but are local in extent and of short duration. They cause damage in scattered spots. The extent of the damage varies from area to area. Hailstorms occur at times during the warmer part of the year but in an irregular pattern and in only small areas.

History and Development

The history and development of Clay and Ray Counties are closely related. The area was inhabited by the Missouri, Sac, and Iowa Indians when European settlers arrived. As part of the Louisiana Territory, it was under French dominance until 1803, when France sold the territory to the United States.

The first permanent settlement was established in an area of Ray County along the Crooked River in 1816 (*11*). Immigration to the county was steady after this settlement was established. The settlers in both counties came mostly from Tennessee, Kentucky, and Virginia. They generally built their homes on the wooded loess-covered hills. The timber furnished material for homes and fuel. Wild game was a plentiful food supply, and the skins were used as a medium of exchange because money was scarce. The settlers believed that the prairie areas were unsuitable for all agricultural uses, except for livestock pasture.

Ray County was organized out of the territory of Howard County in 1820. It orginally included all or part of 12 other counties, including Clay County. It was reduced to its present size in 1836, when Caldwell County was organized. The county seat originally was Bluffton, in an area along the Missouri River near the present village of Camden. It was moved to Richmond in 1828.

Hunters and trappers lived in what is now Clay County for short periods before title was acquired from the Indians in 1815. The first permanent settlement in this county was established in 1819 (*12*). Settlement was rapid after this settlement was established. The county was formed from part of Ray County in 1822. At this time, Liberty was laid out and named the county seat. Clay County first included the four counties to the north but was reduced to its present size when Clinton County was organized in 1833.

Settlers from southeast Missouri who sustained real estate losses because of the New Madrid earthquakes in 1811-12 could claim a similar acreage on any of the public lands of Missouri. There were several New Madrid claims in Clay and Ray Counties, but the total acreage of land involved was small.

The residents of Clay and Ray Counties suffered from troops and raiders from both the North and South during the Civil War. The unrest and bloodshed greatly retarded the development of agriculture in the area. Even after the war, former friends and neighbors continued to retaliate for both real and imagined wrongs. Clay County was the home of Frank and Jesse James, and this area was a favorite hideout for them after they committed their crimes.

Agriculture has always been the most important industry in Ray County. It formerly was the most important enterprise in Clay County, but in recent years commerce and industry have become more important. Coal mining was an important industry in Ray County from about

1870 to the early 1950's. The number of farms in both counties was highest in about 1900. Since then, the number has decreased and the size has increased.

The early settlers practiced a subsistence type of farming. They grew corn for food and tobacco and hemp for cash. Very little hemp was grown after 1870. Tobacco production also has declined. Currently, only a few acres in the two counties are used for tobacco.

The acreage used for corn increased until about 1900, when it was about 72,000 acres in Clay County and 115,000 acres in Ray County (*4*). Yield per acre was about 36 bushels. After 1900, the acreage decreased steadily in both counties, but yields increased. In 1979, about 12,400 acres in Clay County and 25,500 acres in Ray County were used for corn. The average yield was about 107 bushels per acre in Clay County and 109 bushels per acre in Ray County.

Soybean production started in both counties in the late 1940's. In 1950, soybeans were grown on about 200 acres in Clay County and 4,000 acres in Ray County. In 1979, they were grown on about 22,000 acres in Clay County and 100,000 acres in Ray County. The average yield in that year was more than 33 bushels per acre in Clay County, and more than 35 bushels per acre in Ray County.

Wheat and grain sorghum generally are minor crops in both counties. The acreage used for wheat fluctuates, depending on the market price. In the last few years it has increased because soybeans and wheat have been double cropped.

The raising of livestock is an enterprise in both counties.

In 1937, the enactment of legislation establishing soil conservation districts stirred the interest of many landowners in both counties. The Clay County Soil and Water Conservation District was organized in 1943. It was the ninth soil conservation district in Missouri. The Ray County Soil and Water Conservation District was organized in 1945. It was the 17th soil conservation district in Missouri.

Physiography, Relief, and Drainage

Clay and Ray Counties are in several physiographic areas. The southern part of both counties is the flood plain along the Missouri River. This flood plain is less than 1/4 mile to about 7 miles wide at the widest point. It generally is level or nearly level, but the slope is more than 5 percent on some of the old natural levees. The silty and sandy soils generally are closer to the river channel and the more clayey soils farther away. Some of the old channels are low and wet and can be farmed only during periods of low rainfall.

The bedrock in Clay and Ray Counties consists of cyclic deposits of limestone and shale (*6*). The tilt of the bedrock generally is from southeast to northwest. Bethany Falls limestone is the most conspicuous rock formation in the two counties. It is the most extensively quarried limestone in northwest Missouri. Some of the abandoned underground quarries in Clay County are being developed for storage and other industrial uses (fig. 2).

The uplands are highly dissected glacial till plains covered by loess of varying thicknesses. The loess is thickest on the highly dissected hills close to the flood plain along the Missouri River. It gradually thins to the northeast, where the ridgetops are loess covered and glacial till is on the side slopes. Pennsylvanian bedrock is exposed along the more deeply entrenched drainageways and on steep river bluffs.

Elevation ranges from about 670 feet above sea level in an area on the Missouri River in the southeast corner of Ray County to about 1,100 feet on the highest ridges in the uplands.

Most of the surface water in Clay and Ray Counties drains directly into the Missouri River. The water in some areas in the northwestern part of Clay County drains westward into the Platte River, and the water in some areas in the northeastern part of Ray County drains eastward into the Grand River. These waters eventually flow into the Missouri River. The major tributaries are Fishing River and Shoal and Brush Creeks in Clay County and Crooked River and Willow, Kinney, Rollins, and Cravens Creeks in Ray County.

Water Supply

Most of the soils on the uplands in Clay and Ray Counties are suitable for the construction of ponds and small reservoirs. These impoundments provide most of the livestock water. Lawson gets part of its water from a small lake.

The water from the consolidated rock formations that underlie Clay and Ray Counties generally is of poor quality. It is below chemical drinking water standards of the United States Public Health Service. Water from deep wells is high in chlorides and sulfates. Yields from shallow wells generally are low, usually about 5 gallons per minute, and of these wells many go dry during periods of low rainfall (*7*). Some rural landowners, however, have wells that supply an adequate amount of good-quality water.

The wells in the alluvium along the smaller streams supply minor amounts of water. Smithville, in the northwestern part of Clay County, gets its water from wells in the alluvium along the Little Platte River. A well in the alluvium along the East Fork of Crooked River supplies water to the residents of Millville, in Ray County. Kearney, a town in the central part of Clay County, gets its water from wells in the alluvium along Fishing River.

The principal source of ground water for Clay and Ray Counties is the alluvium along the Missouri River (*8*). This source is widely used by most of the larger cities and towns in the two counties and by the cities and towns south of the river. Rural water districts, which get

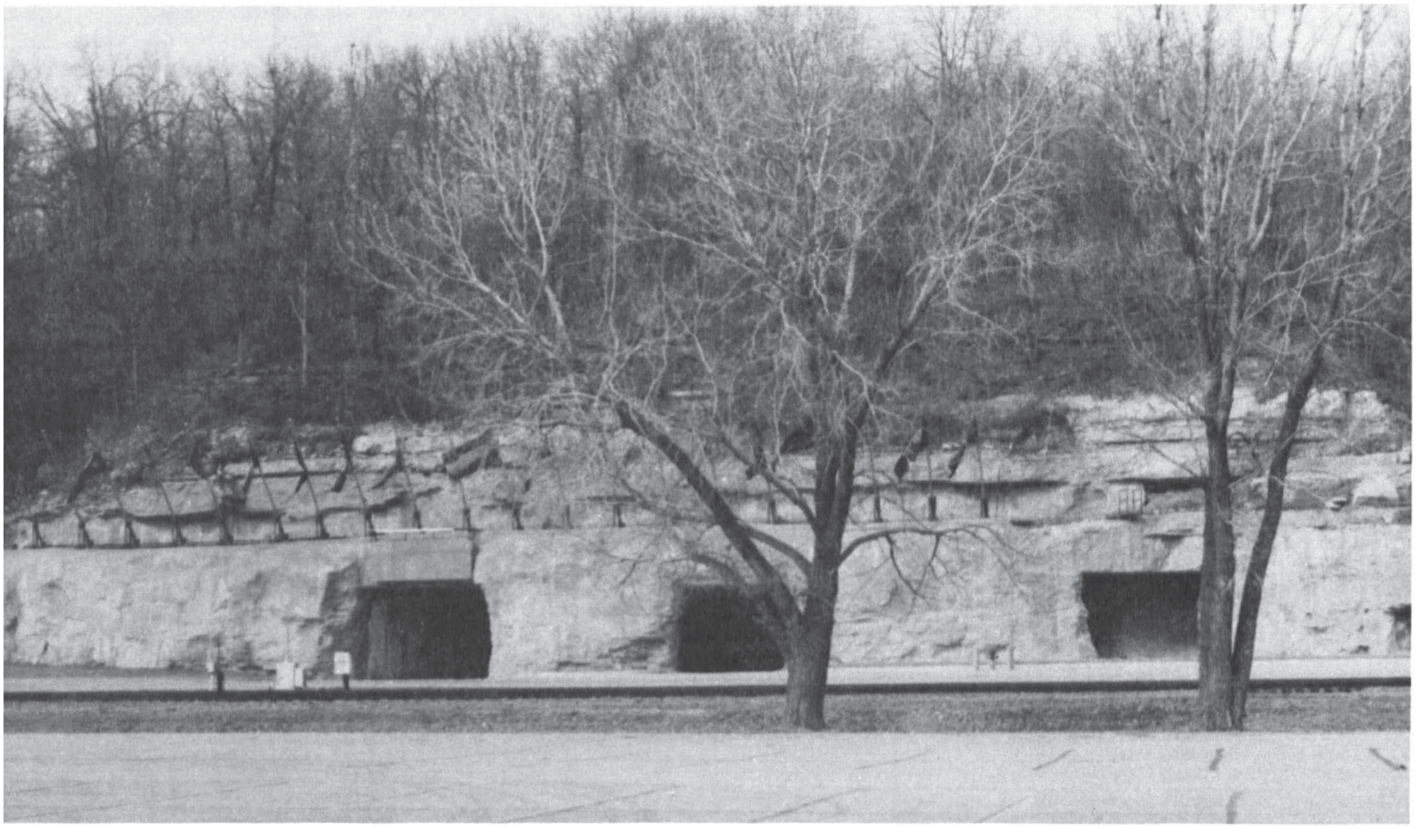

Figure 2.—Entrances to storage areas in Bethany Falls limestone.

their water from this source, serve many areas in Clay and Ray Counties. Also, several irrigation systems, which have been installed in the last few years, use this source of water. The water table in the alluvium along the Missouri River generally is between 5 and 25 feet below the surface of the flood plain. The thickness of the alluvium reaches a maximum of 100 feet and averages 80 to 90 feet.

If installed in favorable locations, wells of modern construction could yield more than 2,000 gallons per minute. Data from the Kansas City area indicate, however, that actual yields are between 500 and 1,500 gallons per minute.

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 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.

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, names, and delineations of the soils identified on the general soil map of this survey area do not fully agree with those in the surveys of adjacent counties published at a different date. Differences are the result of additional soil data, variations in the intensity of mapping, and correlation decisions that reflect local conditions. In some areas combining small acreages of similar soils that respond to use and management in much the same way was more practical than separating these soils and giving them different names.

Soil Descriptions

1. Grundy-Lagonda association

Deep, gently sloping and moderately sloping, somewhat poorly drained soils formed in loess or in loess and pedisediments; on uplands

This association is on ridgetops and side slopes on high, broad divides between the major drainageways. It makes up about 6 percent of the survey area. It is about 45 percent Grundy soils, 34 percent Lagonda and similar soils, and 21 percent soils of minor extent.

Grundy soils generally are on broad ridgetops and the less dissected, slightly concave side slopes. Typically, they have a surface layer of very dark grayish brown silt loam and a subsurface layer of very dark grayish brown silty clay loam. The subsoil is dark grayish brown and grayish brown, mottled silty clay and silty clay loam. The substratum is grayish brown, mottled silty clay loam.

Lagonda soils generally are on the narrower ridgetops and the ends of ridges and on the more dissected, slightly concave side slopes. Typically, they have a surface layer of very dark gray silt loam and a subsurface layer of very dark gray silty clay loam. The subsoil is dark grayish brown and grayish brown, mottled silty clay and silty clay loam. The substratum is mottled gray, brown, and yellowish brown silty clay loam.

The minor soils are the moderately well drained Armster, Nodaway, and Sharpsburg soils. Armster soils are on the ends of ridges and the steeper side slopes. Nodaway soils are on flood plains along small streams. Sharpsburg soils are on narrow ridgetops and the ends of ridges.

Grain farming and some general livestock farming are the main enterprises in this association. Soybeans, corn, and small grain are the major crops. Grasses and wetness-tolerant legumes are grown on a small part of the association. Measures that help to control erosion, drain seepy areas, and maintain tilth and fertility are the major management needs.

This association is suited to building site development and sanitary facilities. Wetness, slow permeability, and a high shrink-swell potential are the major limitations.

2. Armster-Lagonda-Sharpsburg association

Deep, gently sloping to moderately steep, moderately well drained and somewhat poorly drained soils formed in loess, pedisediments, and glacial till; on uplands

This association is on narrow ridgetops and moderately dissected side slopes adjacent to small drainageways. It makes up about 20 percent of the survey area. It is about 34 percent Armster and similar soils, 32 percent Lagonda and similar soils, 16 percent Sharpsburg soils, and 18 percent soils of minor extent.

Armster soils are moderately well drained and are on narrow ridgetops and convex side slopes. Typically, they have a surface layer of very dark grayish brown loam. The subsoil is brown clay loam and sandy clay in the upper part and dark yellowish brown and yellowish brown, mottled sandy clay and sandy clay loam in the lower part. The substratum is multicolored sandy clay loam.

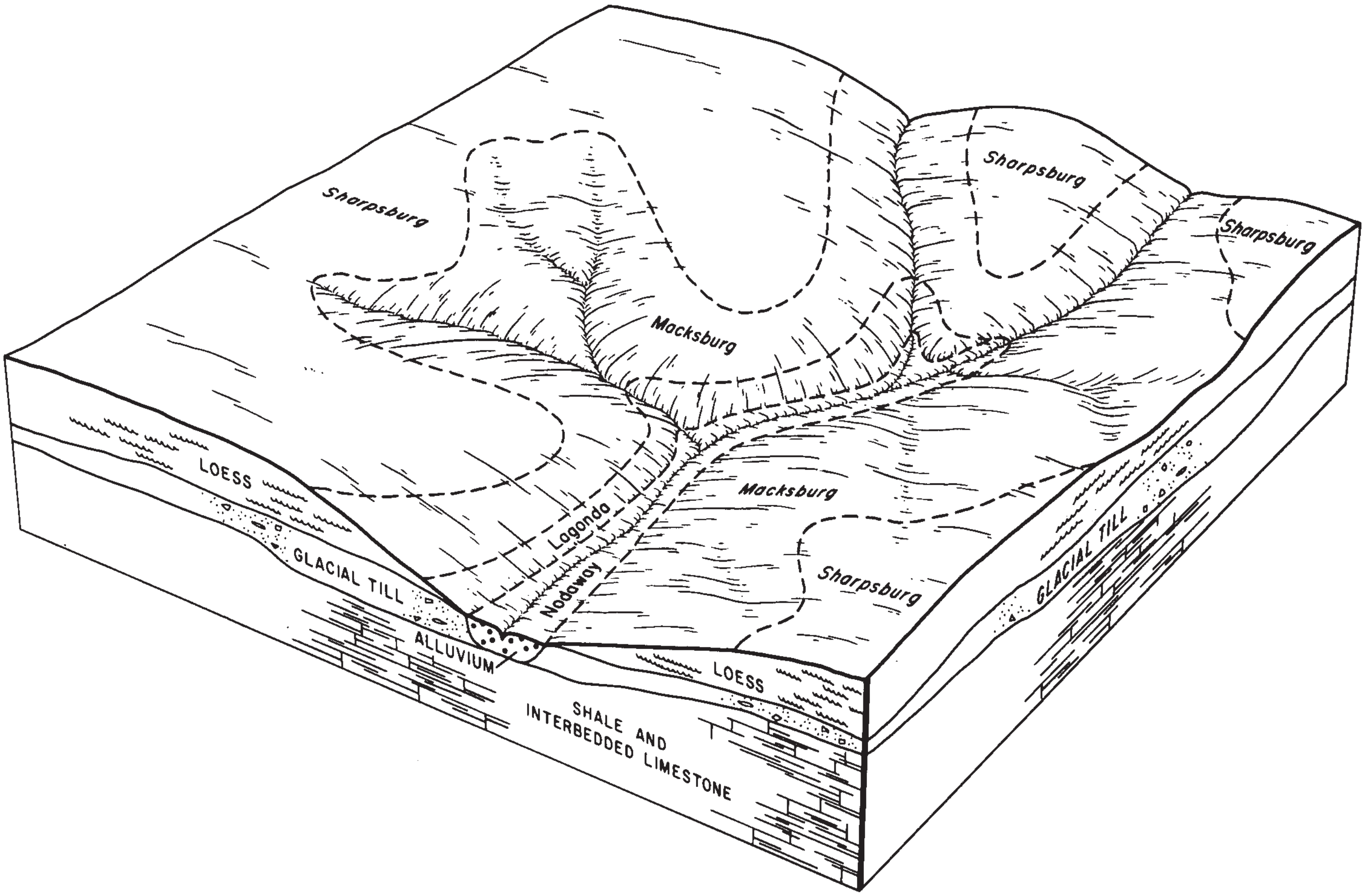

Figure 3.—Pattern of soils and parent material in the Sharpsburg-Macksburg association.

Lagonda soils are somewhat poorly drained and are on ridgetops, at the head of drainageways, and on slightly concave side slopes. Typically, they have a surface layer of very dark gray silt loam and a subsurface layer of very dark gray silty clay loam. The subsoil is dark grayish brown and grayish brown, mottled silty clay and silty clay loam. The substratum is mottled gray, brown, and yellowish brown silty clay loam in the Lagonda soils.

Sharpsburg soils are moderately well drained and commonly are on the narrow tops and ends of ridges. Typically, they have a surface layer of black silt loam and a subsurface layer of very dark grayish brown silt loam. The subsoil is dark brown and dark yellowish brown silty clay loam in the upper part and multicolored silty clay loam in the lower part. The substratum is mottled grayish brown and dark yellowish brown silt loam.

The minor soils are the moderately well drained Nodaway and Snead soils and the poorly drained Sampsel soils. Nodaway soils are silty throughout. They are on flood plains along small streams. Sampsel soils are grayer than the major soils. They are on concave foot slopes. Snead soils are moderately deep. They are on the lower, steeper side slopes.

General livestock farming and grain farming are the main enterprises in this association. Soybeans, corn, and small grain are grown in the less sloping areas. Most of the steeper areas are used for pasture or hay. Measures that help to control erosion, drain seepy areas, and maintain tilth and fertility are the major management needs.

This association is suited to building site development and sanitary facilities. A high shrink-swell potential, slope, moderately slow or slow permeability, and wetness are the major limitations.

3. Sharpsburg-Macksburg association

Deep, gently sloping to strongly sloping, moderately well *drained and somewhat poorly drained soils formed in loess; on uplands*

This association is on narrow ridgetops and smooth, short, slightly concave side slopes. It makes up about 15 percent of the survey area. It is about 53 percent Sharpsburg and similar soils, 32 percent Macksburg and similar soils, and 15 percent soils of minor extent (fig. 3).

Sharpsburg soils are moderately well drained and are on narrow ridgetops, convex side slopes, and the ends of ridges. Typically, they have a surface layer of black silt loam and a subsurface layer of very dark grayish brown silt loam. The subsoil is silty clay loam. It is dark brown and dark yellowish brown in the upper part and multicolored in the lower part. The substratum is mottled grayish brown and dark yellowish brown silt loam.

Macksburg soils are somewhat poorly drained and are on slightly concave side slopes and at the head of drainageways. Typically, they have a surface layer of black silt loam and a subsurface layer of black and very dark grayish brown silty clay loam. The subsoil is dark grayish brown and grayish brown, mottled silty clay loam. The substratum is grayish brown, mottled silty clay loam.

The minor soils are Armster, Lagonda, and Nodaway soils. Also of minor extent are built-up areas of Urban land, upland, 5 to 9 percent slopes. Armster soils contain glacial sand and gravel. They are on the steeper side slopes. Lagonda soils are similar to the Macksburg soils. Nodaway soils are silty throughout. They are on flood plains along small streams.

Grain farming and livestock farming are the main enterprises in this association. Soybeans, small grain, and corn are the major crops. Cool-season grasses and legumes are grown for pasture and hay. The parts of the association near metropolitan areas are used for subdivisions. Measures that help to control erosion and drain seepy areas are the major management needs.

This association is suited to building site development and sanitary facilities. Wetness, a high shrink-swell potential, low strength, and the high content of clay are the major limitations.

4. Snead-Ladoga association

Moderately deep and deep, gently sloping to steep, moderately well drained soils formed in shale and limestone residuum or in loess; on uplands

This association is on moderately dissected, narrow ridgetops and short side slopes close to the major

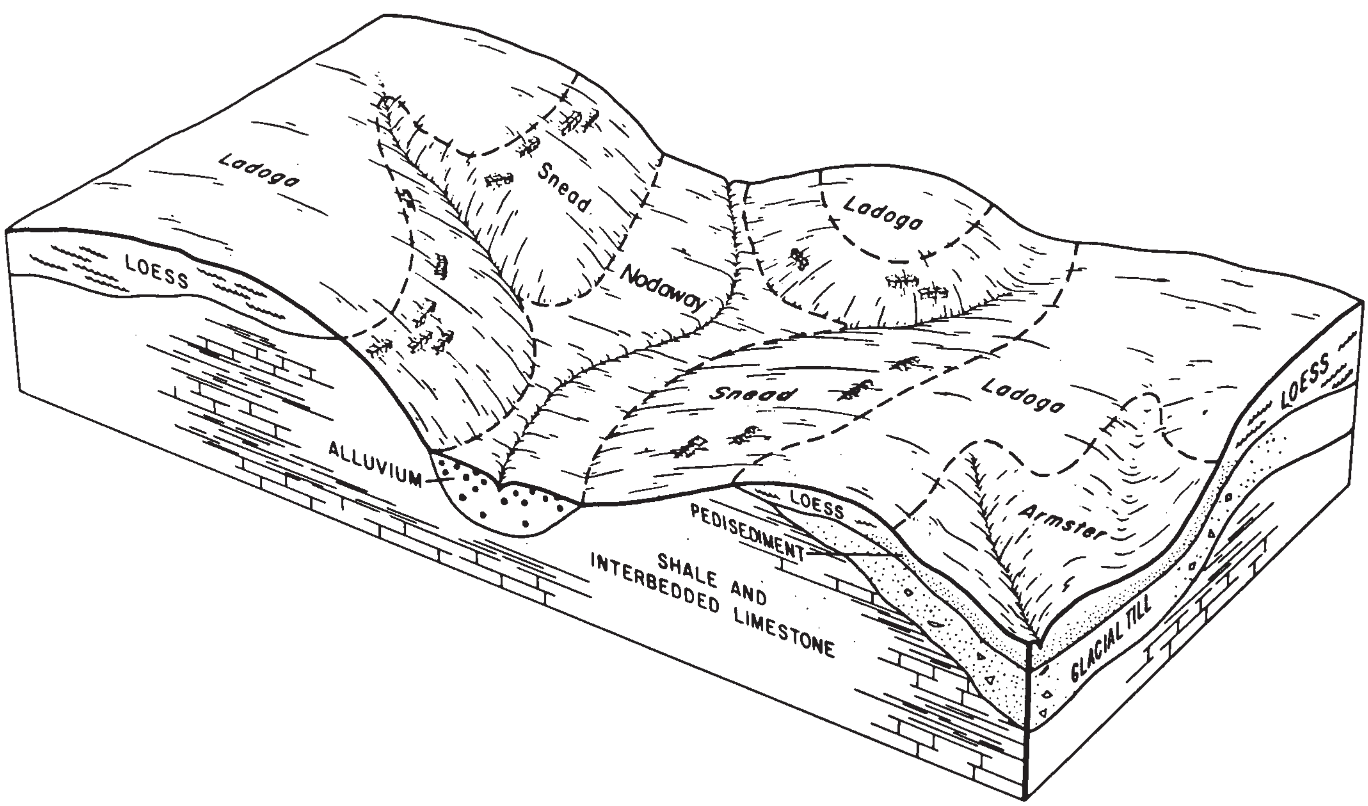

Figure 4.—Pattern of soils and parent material in the Snead-Ladoga association.

drainageways. It makes up about 16 percent of the survey area. It is about 43 percent Snead soils, 35 percent Ladoga and similar soils, and 22 percent soils of minor extent (fig. 4).

Snead soils are moderately deep and are on side slopes close to the drainageways. Typically, they have a surface layer of very dark brown flaggy silty clay loam and a subsurface layer of very dark brown and very dark grayish brown flaggy silty clay loam and flaggy silty clay. The subsoil is dark grayish brown, mottled silty clay. The substratum is dark grayish brown, grayish brown, and olive brown silty clay. It is underlain by soft, weathered shale bedrock.

Ladoga soils are deep and generally are on ridgetops and side slopes above the Snead soils. Typically, they have a surface layer of very dark grayish brown silt loam and a subsurface layer of dark grayish brown silt loam. The subsoil is dark yellowish brown and yellowish brown silty clay loam. It is mottled in the lower part. The substratum is yellowish brown, mottled silty clay loam.

The minor soils are Armster, Greenton, Nodaway, and Sampsel soils. Armster soils are similar to the Ladoga soils. Greenton soils are somewhat poorly drained and generally are in areas below the Snead soils. Nodaway soils have less clay than the major soils. They are on flood plains along small streams. Sampsel soils are poorly drained and are in areas below the Snead soils.

About 50 percent of this association is cleared and is used for pasture, hay, or cultivated crops. Soybeans, wheat, and grain sorghum are the major crops. Grasses and legumes are grown for pasture and hay. Erosion and the slope are the major management problems. Overgrazing or excessive use of pastures during wet periods results in rapid erosion.

The uncleared acreage is mostly rough, strongly sloping to steep areas of the Snead soils. It generally

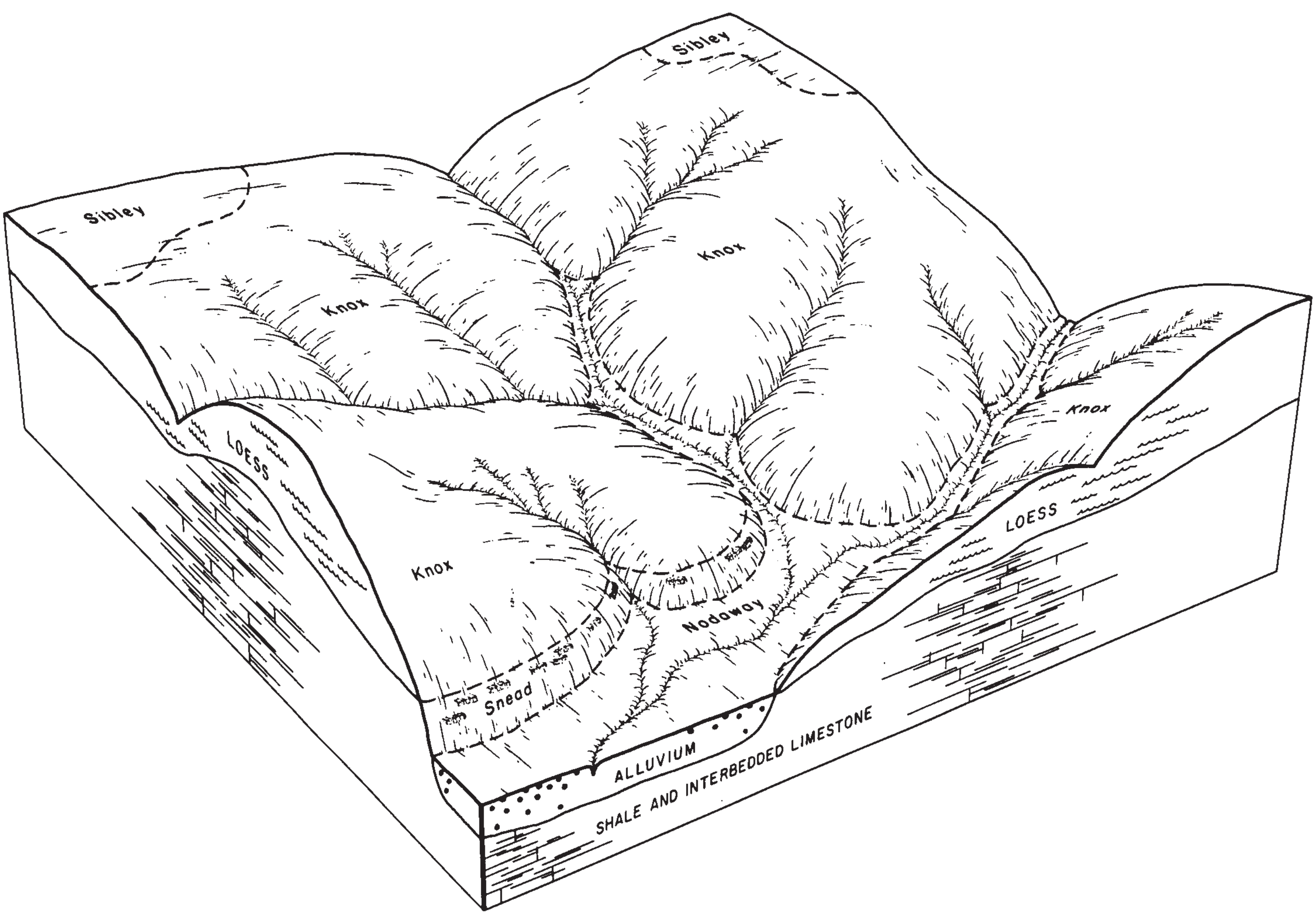

Figure 5.—Pattern of soils and parent material in the Knox-Sibley association.

supports native hardwoods. Oak and hickory are the predominant species. The steep slopes restrict the use of logging equipment, and erosion is a hazard along logging roads and skid trails.

This association is suited to building site development and sanitary facilities. Moderately slow or slow permeability, slope, a high shrink-swell potential, wetness, depth to bedrock, and stones are the major limitations.

5. Knox-Sibley association

Deep, gently sloping to steep, well drained soils formed in a thick layer of loess; on uplands

This association is on narrow and moderately wide ridgetops and side slopes. Slopes generally are short.

This association makes up about 11 percent of the survey area. It is about 61 percent Knox soils, 15 percent Sibley and similar soils, and 24 percent soils of minor extent (fig. 5).

Knox soils are on narrow ridgetops and convex side slopes. Typically, they have a surface layer of dark brown silt loam. The subsoil is dark yellowish brown silty clay loam. The substratum is brown silt loam.

Sibley soils are on moderately wide ridgetops and convex side slopes. Typically, they have a surface layer of very dark grayish brown silt loam. The subsoil is silty clay loam. It is very dark grayish brown in the upper part and dark brown, dark yellowish brown, and grayish brown in the lower part. The substratum is mottled dark yellowish brown, grayish brown, and strong brown silt loam.

The minor soils are the somewhat poorly drained Higginsville soils and the moderately well drained Nodaway and Snead soils. Higginsville soils are at the head of drainageways. Nodaway soils are on flood plains along small streams. Snead soils are moderately deep. They are on side slopes below the Knox soils.

About 70 percent of this association is cleared and is used as cropland or pasture. Soybeans, wheat, and corn are grown in the less sloping areas. Cool-season grasses and legumes are grown for pasture and hay. Measures that help to control erosion are the major management needs if row crops are grown. Overgrazing pastures during wet periods results in rapid erosion in the steep areas.

The uncleared acreage is mostly moderately steep and steep areas of the Knox soils. Oak and hickory are the predominant trees. The steep slopes restrict the use of logging equipment, and erosion is a hazard along logging roads and skid trails.

This association is suited to building site development and sanitary facilities. The slope, a high shrink-swell potential, and the potential for frost action are the major limitations.

6. Lagonda-Sharpsburg association

Deep, gently sloping to strongly sloping, somewhat poorly drained and moderately well drained soils formed in loess or in loess and pedisediments; on uplands

This association is on narrow ridgetops and side slopes on broad divides between the major drainageways. It makes up about 8 percent of the survey area. It is about 56 percent Lagonda and similar soils, 31 percent Sharpsburg soils, and 13 percent soils of minor extent (fig. 6).

Lagonda soils are somewhat poorly drained and are on concave side slopes. Typically, they have a surface layer of very dark gray silt loam and a subsurface layer of very dark gray silty clay loam. The subsoil is dark grayish brown and grayish brown, mottled silty clay and silty clay loam. The substratum is mottled gray, brown, and yellowish brown silty clay loam.

Sharpsburg soils are moderately well drained and are on narrow ridgetops and the ends of ridges and on convex side slopes. Typically, they have a surface layer of very dark grayish brown silt loam and a subsurface layer of very dark grayish brown silty clay loam. The subsoil is dark brown and grayish brown, mottled silty clay and silty clay loam. The substratum is mottled gray, brown, and yellowish brown silty clay loam.

The minor soils are Armster and Nodaway soils. Armster soils are on the steeper convex side slopes. They contain glacial sand and gravel. Their dark surface layer is thinner than that of the major soils. Nodaway soils are silty throughout. They are on flood plains along small streams.

Grain farming and livestock farming are the main enterprises in this association. Soybeans, corn, and small grain are the major crops. Cool-season grasses and legumes are grown for pasture and hay. Measures that help to control erosion, drain seepy areas, and maintain tilth and fertility are the major management needs.

This association is suited to building site development and sanitary facilities. Wetness, a high shrink-swell potential, the potential for frost action, and moderately slow or slow permeability are the major limitations.

7. Zook-Nodaway-Bremer association

Deep, nearly level, poorly drained and moderately well drained soils formed in alluvium; on flood plains and terraces

This association is on flood plains along the intermediate and small tributaries of the Missouri River. It makes up about 9 percent of the survey area. It is about 38 percent Zook and similar soils, 25 percent Nodaway soils, 19 percent Bremer soils, and 18 percent soils of minor extent.

Zook soils are poorly drained and are on flood plains along small streams. Typically, they have a surface layer

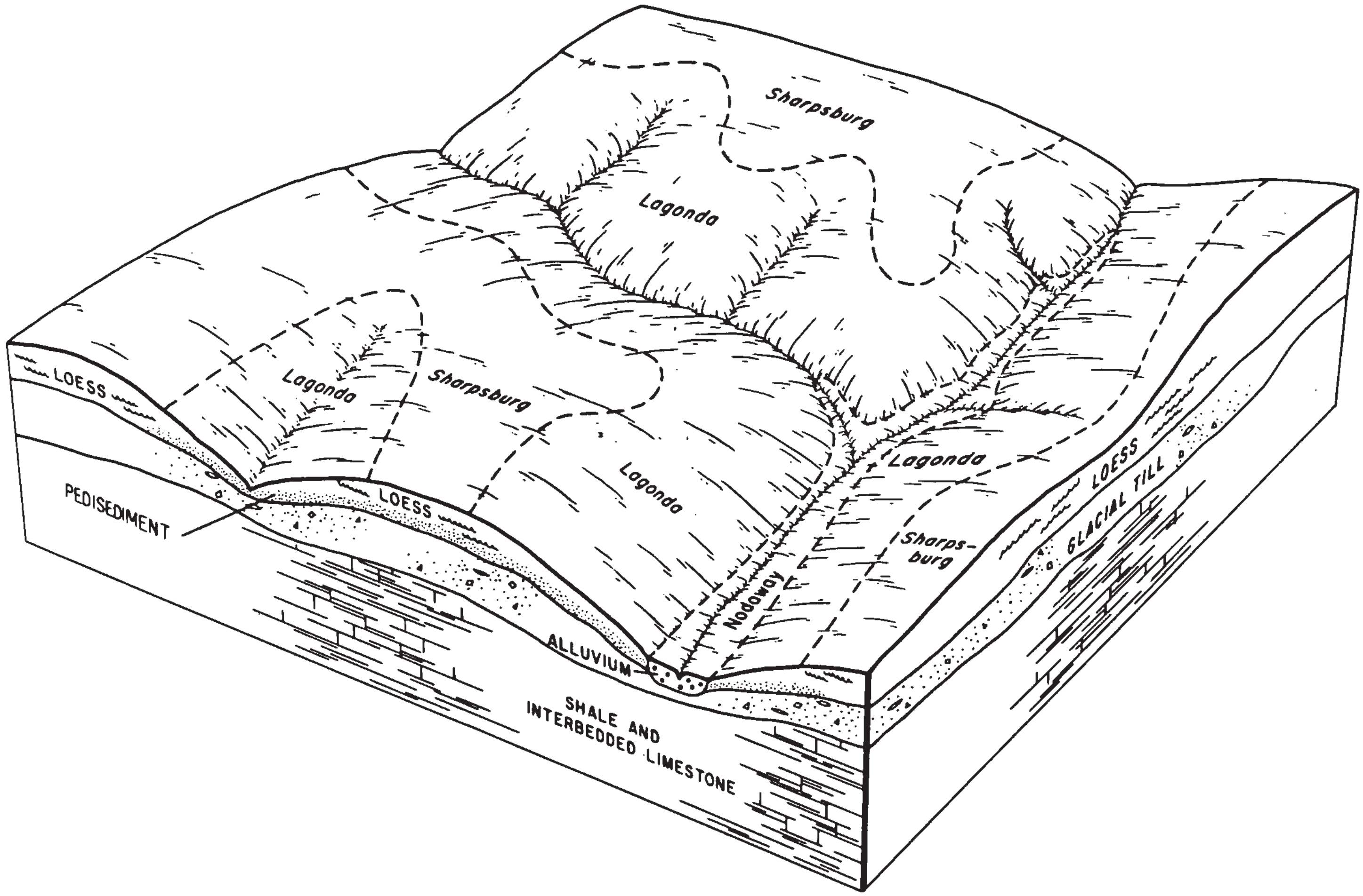

Figure 6.—Pattern of soils and parent material in the Lagonda-Sharpsburg association.

of black silty clay loam and a subsurface layer of very dark gray silty clay loam. The subsoil is dark gray silty clay loam. The substratum is mottled dark gray and dark grayish brown silty clay loam.

Nodaway soils are moderately well drained and are on flood plains near the stream channels. Typically, they have a surface layer of very dark grayish brown silt loam. The substratum is stratified very dark grayish brown and dark grayish brown silt loam.

Bremer soils are poorly drained and are on low stream terraces along small streams. Typically, they have a surface layer of black silt loam and a subsurface layer of black silty clay loam. The subsoil is mottled silty clay loam. It is very dark gray in the upper part and dark gray and gray in the lower part. The substratum is gray, mottled silty clay loam.

The minor soils are Moniteau and Wiota soils. Moniteau soils have a gray silt loam subsurface layer and a gray silty clay loam subsoil. They are on high stream terraces. Wiota soils are well drained and are on low stream terraces.

Grain farming is the main enterprise in this association. Soybeans, corn, and small grain are the major crops. Flooding and wetness are the major management concerns. The high content of clay in the Zook soils also is a concern.

This association generally is unsuitable for building site development and sanitary facilities because of wetness and flooding.

8. Leta-Haynie-Waldron association

Deep, nearly level, somewhat poorly drained and moderately well drained soils formed in alluvium; on flood plains

This association is on the wide flood plains along the Missouri River. It makes up about 15 percent of the survey area. It is about 33 percent Leta and similar soils, 14 percent Haynie soils, 11 percent Waldron soils, and 42 percent soils of minor extent.

Leta soils are somewhat poorly drained and are in the lower areas on the flood plains. Typically, they have a surface layer of very dark gray silty clay. The subsurface layer also is very dark gray silty clay. The subsoil is dark grayish brown silty clay. The substratum is stratified, light olive brown, dark grayish brown, and grayish brown silt loam and very fine sandy loam.

Haynie soils are moderately well drained and are in the slightly higher positions on the flood plains. Typically, the surface layer is very dark grayish brown silt loam. The substratum is dark grayish brown, mottled very fine sandy loam in the upper part and dark grayish brown silt loam and grayish brown very fine sandy loam and loamy fine sand in the lower part.

Waldron soils are somewhat poorly drained. They are in the lower areas on the flood plains but are slightly higher than the Leta soils. Typically, they have a surface layer of very dark gray silty clay loam. The substratum is stratified, very dark grayish brown silty clay and clay in the upper part; stratified, dark grayish brown, mottled silty clay and grayish brown very fine sandy loam in the next part; and very dark grayish brown silty clay and dark grayish brown, mottled silty clay in the lower part.

The minor soils are Booker, Cotter, Gilliam, and Modale soils. Booker soils are very poorly drained and are in the lower areas. Cotter soils are well drained and are in the slightly higher areas. Gilliam soils are grayer than the Haynie soils. They are in the lower areas. Modale soils also are in the lower areas. They are loamy in the upper part and clayey in the lower part.

Grain farming is the main enterprise in this association. Soybeans, wheat, and corn are the major crops. Wetness and a high content of clay are the main concerns in managing the Leta and Waldron soils.

This association generally is unsuited to building site development and sanitary facilities, mainly because of flooding and wetness. A high shrink-swell potential, seepage, slow permeability, and low strength also are management concerns.

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, Knox silt loam, 20 to 30 percent slopes, is one of several phases in the Knox 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 of 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. Snead-Rock outcrop complex, 14 to 30 percent slopes, is an example.

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

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, quarries, is an example. The larger miscellaneous areas are shown on the soil maps.

The descriptions, names, and delineations of the soils identified on the detailed soil maps of this survey area do not fully agree with those in the surveys of adjacent counties published at a different date. Differences are the result of additional soil data, variations in the intensity of mapping, and correlation decisions that reflect local conditions. In some areas combining small acreages of similar soils that respond to use and management in much the same way was more practical than separating these soils and giving them different names.

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

1B—Sibley silt loam, 2 to 5 percent slopes. This deep, gently sloping, well drained soil is on the moderately wide, convex tops of upland ridges. Individual areas are long and moderately wide and range from 10 to 150 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 11 inches thick. The subsoil is friable and firm silty clay loam about 38 inches thick. The upper part is very dark grayish brown, and the lower part is dark brown, dark yellowish brown, and grayish brown. The substratum to a depth of about 72 inches is mottled dark yellowish brown, grayish brown, and strong brown, friable silt loam. In some areas, the very dark upper layers are less than 24 inches thick and gray mottles are within a depth of 36 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Higginsville and Macksburg soils. These soils are on side slopes below the Sibley soil. They make up less than 5 percent of the unit.

Permeability is moderate in the Sibley soil. Surface runoff is medium in cultivated areas. Reaction is neutral to medium acid in the subsoil and varies widely in the surface layer as a result of local liming practices. Natural fertility is high, and organic matter content is moderate. Available water capacity is very high. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled throughout a moderately wide range of moisture content. It tends to crust or puddle, however, after hard rains.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghum, and small grain. If cultivated crops are grown, erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, winter cover crops, and grassed waterways help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. This soil is suited to alfalfa, smooth bromegrass, and other grasses and legumes. If alfalfa is grown, the fertility level should be high. The plants should be cut by the early bloom stage and should be at least 6 inches high just before winter. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates and pasture rotation improve the pasture.

This soil is suited to building site development and onsite waste disposal. The shrink-swell potential is a limitation on sites for dwellings. Adequately reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. Septic tank systems function well if they are properly installed. Slope and seepage are limitations on sites for sewage lagoons. Grading helps to level the site. Providing slowly permeable material helps to seal the lagoon and thus helps to prevent seepage.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIe.

1C—Sibley silt loam, 5 to 9 percent slopes. This deep, moderately sloping, well drained soil is on convex side slopes and narrow ridgetops in the uplands. Individual areas are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 7 inches thick. The subsoil is friable silty clay loam about 32 inches thick. The upper part is dark brown, and the lower part is brown. The substratum to a depth of about 60 inches is brown, friable silt loam. In some areas the soil is eroded and has a thinner dark surface layer. In other areas grayish brown mottles are within a depth of 36 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Higginsville and moderately well drained Sharpsburg soils. Higginsville soils are at the head of drainageways and on the lower parts of the side slopes. Sharpsburg soils are on the steeper side slopes. Included soils make up less than 5 percent of the unit.

Permeability is moderate in the Sibley soil. Surface runoff is medium in cultivated areas. Reaction is medium acid to neutral in the subsoil and varies widely in the surface layer as a result of local liming practices. Natural fertility is high, and organic matter content is moderate. Available water capacity is very high. The shrink-swell potential is moderate. The surface layer is friable and can be tilled throughout a moderately wide range of moisture content. It crusts or puddles, however, especially after hard rains.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghum, and small grain. If cultivated crops are grown, erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, winter cover crops, and grassed waterways help to prevent excessive soil loss. Most areas can be terraced and farmed on the contour. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. This soil is suited to alfalfa, smooth bromegrass, and other grasses and legumes. If alfalfa is grown, the fertility level should be high. The plants should be cut by the early bloom stage and should be at least 6 inches high just before winter. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates and pasture rotation improve the pasture.

This soil is suited to building site development and onsite waste disposal. The shrink-swell potential is a limitation on sites for dwellings. Adequately reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. Septic tank systems function well if they are properly installed. Slope and seepage are limitations on sites for sewage lagoons. The less sloping areas should be selected as sites for the lagoons. Providing slowly permeable material helps to seal the lagoon and thus helps to prevent seepage.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts in low areas improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIIe.

2C—Higginsville silt loam, 5 to 9 percent slopes. This deep, moderately sloping, somewhat poorly drained soil is on slightly concave side slopes in the uplands. Individual areas are irregular in shape and range from 15 to 100 acres in size.

Typically, the surface layer is very dark brown, friable silt loam about 10 inches thick. The subsoil is firm, mottled silty clay loam about 39 inches thick. The upper part is very dark grayish brown and mixed dark grayish brown and grayish brown, and the lower part is grayish brown. The substratum to a depth of about 60 inches is grayish brown, mottled, friable silt loam. In some areas the surface layer is very dark grayish brown silty clay loam.

Included with this soil in mapping are small areas of Lagonda soils and small areas of the moderately well drained Sharpsburg soils. Lagonda soils contain more clay than the Higginsville soil. They are on the ends of ridges and on side slopes. Sharpsburg soils are on the ends of ridges. Included soils make up about 5 percent of the unit.

Permeability is moderate in the Higginsville soil. Surface runoff is medium. Reaction ranges from slightly acid to strongly acid in the subsoil and varies widely in the surface layer as a result of local liming practices. Natural fertility is high, and organic matter content is moderate. Available water capacity is high. A seasonal high water table commonly is at a depth of 1.5 to 3.0 feet during winter and spring. The shrink-swell potential is moderate in the subsoil. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. It tends to crust or puddle, however, after hard rains, especially in areas where the plow layer contains subsoil material.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghum, and small grain. If cultivated crops are grown, erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, winter cover crops, and grassed waterways help to prevent excessive soil loss. Most areas can be terraced and farmed on the contour. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration. Some areas are wet and seepy. Properly located drainage tile reduces the wetness of these areas.

A cover of pasture plants or hay is effective in controlling erosion. This soil is better suited to shallow-rooted legumes and to cool-season bunch grasses or native warm-season grasses than to other grasses or legumes. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods improve the pasture.

This soil is suitable for building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations or basement walls help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry.

This soil generally is unsuitable as a septic tank absorption field because of the wetness. Sewage lagoons function adequately if the site can be leveled and the berms and bottom of the lagoon are sealed with slowly permeable material, which helps to prevent the contamination of the ground water. Also, waste generally can be piped to adjacent areas that are suitable for onsite waste disposal.

Low strength, the potential for frost action, the shrink-swell potential, and the wetness are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action, shrinking and swelling, and wetness. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIIe.

5C—Macksburg silt loam, 5 to 9 percent slopes. This deep, moderately sloping, somewhat poorly drained soil is on slightly concave side slopes at the head of upland drainageways. Individual areas are irregular in shape and range from 10 to 80 acres in size.

Typically, the surface layer is black, friable silt loam about 7 inches thick. The subsurface layer is black and very dark grayish brown, friable silty clay loam about 12 inches thick. The subsoil is dark grayish brown and grayish brown, mottled, firm silty clay loam about 29 inches thick. The substratum to a depth of about 61 inches is grayish brown, mottled, friable silty clay loam. In some areas the dark surface soil is less than 10 inches thick. In other areas the subsoil contains more sand and clay.

Included with this soil in mapping are small areas of the moderately well drained Sharpsburg soils. These soils are on the tops and ends of ridges. They make up about 10 percent of the unit.

Permeability is moderately slow in the Macksburg soil. Surface runoff is medium. Reaction is medium acid or strongly acid in the subsoil and varies widely in the surface layer as a result of local liming practices. Natural fertility is high, and organic matter content is moderate. Available water capacity is high. A seasonal high water table commonly is at a depth of 2 to 4 feet during winter and spring. The shrink-swell potential is moderate in the surface soil and high in the subsoil. The surface layer is friable and can be easily tilled at the optimum moisture content. It becomes cloddy, however, if worked when the moisture content is too high. Also, it tends to crust or puddle after hard rains.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghum, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, winter cover crops, and grassed waterways help to prevent excessive soil loss. Most areas can be terraced and farmed on the contour. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. This soil is better suited to shallow-rooted legumes and to cool-season bunch grasses or native warm-season grasses than to other grasses or legumes. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and restricted use during wet periods improve the pasture.

This soil is suitable for building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations or basement walls help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry.

This soil generally is unsuitable as a septic tank absorption field because of the wetness. Sewage lagoons can function adequately only if they are sealed with slowly permeable material, which helps to prevent the contamination of the ground water. Also, waste can be piped to adjacent areas that are suitable for onsite waste disposal.

Low strength, the potential for frost action, the shrink-swell potential, and the wetness are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action, shrinking and swelling, and wetness. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIIe.

6B—Sharpsburg silt loam, 2 to 5 percent slopes. This deep, gently sloping, moderately well drained soil is on convex ridgetops in the uplands. Individual areas generally are long and narrow and range from 5 to more than 40 acres in size.

Typically, the surface layer is black, friable silt loam about 11 inches thick. The subsurface layer is very dark grayish brown, friable silt loam about 6 inches thick. The subsoil is about 38 inches thick. It is dark brown, friable silty clay loam in the upper part and dark yellowish brown, light brownish gray, and yellowish brown, mottled, firm silty clay loam in the lower part. The substratum to a depth of about 60 inches is mottled grayish brown and dark yellowish brown, friable silt loam. In some areas the dark surface layer is thinner.

Included with this soil in mapping are small areas of the somewhat poorly drained Macksburg and well drained Sibley soils. Macksburg soils are at the head of drainageways and in saddles, and Sibley soils are in the slightly higher areas on the ridges. Included soils make up 3 to 8 percent of the unit.

Permeability is moderately slow in the Sharpsburg soil. Surface runoff is medium. Reaction is medium acid or strongly acid in the subsoil and varies widely in the surface layer as a result of local liming practices. Natural fertility is high, and organic matter content is moderate. Available water capacity is very high. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. It tends to crust or puddle, however, after hard rains.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghum, and small grain. If cultivated crops are grown, erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, winter cover crops, and grassed waterways help to prevent excessive soil loss. Most areas can be terraced and farmed on the contour. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. This soil is suited to alfalfa, smooth bromegrass, and other grasses and legumes (fig. 7). Overgrazing or grazing when the soil is wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing improve the pasture.

This soil is suited to building site development and onsite waste disposal. The shrink-swell potential is a limitation on sites for dwellings. Adequately reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations and basement walls help to prevent the structural damage caused by shrinking and

Figure 7.—An area of Sharpsburg silt loam, 2 to 5 percent slopes, used for alfalfa and bromegrass pasture.

swelling. If the soil is used as a septic tank absorption field, the moderately slow permeability is a limitation. It can be overcome, however, by enlarging the absorption field. Slope and seepage are limitations on sites for sewage lagoons. Grading helps to level the site. Providing slowly permeable material helps to seal the lagoon and thus helps to prevent seepage.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts in low areas, improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIe.

6C2—Sharpsburg silt loam, 5 to 9 percent slopes, eroded. This deep, moderately sloping, moderately well drained soil is on convex side slopes in the uplands. Individual areas are irregular in shape and range from 7 to 120 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 8 inches thick. The subsoil is firm silty clay loam about 37 inches thick. The upper part is brown and has a few grayish brown mottles, and the lower part is dark yellowish brown and mottled. The substratum to a depth of about 60 inches is mottled grayish brown and dark brown, friable silt loam. The surface layer is dark brown silty clay loam in areas where plowing has mixed it with the upper part of the subsoil.

Included with this soil in mapping are small areas of the somewhat poorly drained Lagonda and Macksburg and well drained Sibley soils. Lagonda and Macksburg soils are on slightly concave slopes below the Sharpsburg soil and at the head of drainageways. Sibley soils are in the less sloping areas above the Sharpsburg soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Sharpsburg soil. Surface runoff is medium in cultivated areas. Reaction ranges from strongly acid to slightly acid in the subsoil and varies in the surface layer as a result of local liming practices. Natural fertility is medium, and organic matter content is moderate. Available water capacity is high. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. It tends to crust or puddle, however, after hard rains, especially in areas where the plow layer contains subsoil material.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghum, and small grain. If cultivated crops are grown, further erosion is a hazard.

A conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, winter cover crops, and grassed waterways help to prevent excessive soil loss. Most areas can be terraced and farmed on the contour. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. This soil is suited to alfalfa, smooth bromegrass, and other grasses and legumes. If alfalfa is grown, the fertility level should be high. The plants should be cut by the early bloom stage and should be at least 6 inches high just before winter. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing improve the pasture.

This soil is suited to building site development and onsite waste disposal. The shrink-swell potential is a limitation on sites for dwellings. Adequately reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. If the soil is used as a septic tank absorption field, the moderately slow permeability is a limitation. It can be overcome, however, by enlarging the absorption field. The laterals should be installed across the slope. Slope and seepage are limitations on sites for sewage lagoons. Grading helps to level the site. Providing slowly permeable material helps to seal the lagoon and thus helps to prevent seepage.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIIe.

6D2—Sharpsburg silt loam, 9 to 14 percent slopes, eroded. This deep, strongly sloping, moderately well drained soil is on convex side slopes and the ends of ridges in the uplands. Individual areas are irregular in shape and range from 6 to 30 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 9 inches thick. The subsoil is firm silty clay loam about 35 inches thick. The upper part is brown, and the lower part is mottled brown, grayish brown, and yellowish brown. The substratum to a depth of about 60 inches is mottled grayish brown and dark yellowish brown, friable silt loam. The surface layer is dark brown silty clay loam in areas where plowing has mixed it with the upper part of the subsoil. In the southern part of the survey area, the subsoil contains less clay.

Included with this soil in mapping are small areas of the loamy Armster soils and the somewhat poorly drained Macksburg soils. Armster soils are on side slopes below the Sharpsburg soil. Macksburg soils are at the head of drainageways. Included soils make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Sharpsburg soil. Surface runoff is rapid in cultivated areas. Reaction is medium acid or strongly acid in the subsoil and varies widely in the surface layer as a result of local liming practices. Natural fertility is medium, and organic matter content is moderate. Available water capacity is high. The shrink-swell potential is moderate. The surface layer is friable. It becomes cloddy, however, if tilled when wet. Also, it tends to puddle or crust after hard rains, especially in areas where the subsoil is mixed with the plow layer.

This soil is moderately suited to corn, soybeans, grain sorghum, and small grain. If cultivated crops are grown, further erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, stripcropping, crop rotations that include grasses and legumes, winter cover crops, terraces, and grassed waterways help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Most areas are pastured. A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is wet, however, causes surface compaction and excessive runoff and damages the stand. Applications of fertilizer, proper stocking rates, pasture rotation, and timely deferment of grazing improve the pasture.

This soil is suitable for building site development and onsite waste disposal. The shrink-swell potential and the slope are limitations on sites for dwellings. Adequately reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand or gravel around the foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The slope can be overcome by land shaping or by designing the dwellings so that they conform to the natural slope of the land. The moderately slow permeability and the slope are limitations on sites for septic tank absorption fields. Enlarging the absorption field helps to overcome the moderately slow permeability. Installing the laterals across the slope or land shaping helps to overcome the slope. Slope and seepage are limitations on sites for sewage lagoons. Grading helps to level the site. Providing slowly permeable material helps to seal the lagoon and thus helps to prevent seepage.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts in low areas improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIIe.

8—Pits, quarries. This map unit is in upland areas from which limestone is or has been quarried. It generally consists of the quarry pits, the stockpiles of lime and crushed rock, the areas covered with overburden spoil, the equipment areas, and the transport roads. Individual areas range from 10 to about 165 acres in size.

The capacity of these areas to support vegetation is limited. It varies from area to area. The vegetation is primarily small trees, annual weeds, and perennial grasses.

The active pits are dry, but most of the abandoned pits contain water. Onsite investigation is needed before any land use decisions are made.

No land capability classification is assigned.

9D—Snead silty clay loam, 5 to 14 percent slopes. This moderately deep, moderately sloping and strongly sloping, moderately well drained soil is on convex side slopes along upland drainageways. Individual areas are long and narrow and range from 5 to 65 acres in size.

Typically, the surface layer is black silty clay loam about 5 inches thick. The subsurface layer is very dark brown and dark brown silty clay about 13 inches thick. The subsoil is grayish brown, firm silty clay about 5 inches thick. The substratum is mottled grayish brown, dark grayish brown, and olive gray, firm clay about 12 inches thick. Soft, weathered shale bedrock is at a depth of about 35 inches.

Included with this soil in mapping are small areas of the deep Armster and Greenton soils. Armster soils occur as narrow bands at the upper edge of the mapped areas. Greenton soils are on side slopes at the lower edge of the mapped areas. Included soils make up about 5 to 10 percent of the unit.

Permeability is slow in the Snead soil. Surface runoff is medium. Reaction is neutral or mildly alkaline in the subsoil. Natural fertility is low, and organic matter content is moderate. Available water capacity is low. A seasonal high water table commonly is at a depth of 2 to 3 feet during winter and spring. The shrink-swell potential is high. The surface layer is firm and can be tilled only within a narrow range in moisture content. If tilled when wet or dry, it becomes cloddy. Also, it becomes compacted if tilled when wet.

Most areas are used for pasture or hay. Some small areas are cultivated along with the surrounding areas. A few areas are used for woodland. This soil is not well suited to row crops and is only moderately well suited to small grain. If the soil is used as cropland, erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, winter cover crops, crop rotations that include grasses and legumes, and grassed waterways help to prevent excessive soil loss. Most areas can be farmed on the contour. Because of the moderate depth to bedrock, however, the soil generally is unsuitable for terracing. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface compaction, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. This soil is better suited to shallow-rooted legumes and cool-season bunch grasses or native warm-season grasses than to other grasses or legumes. Pasture renovation generally is needed because most pastures are in poor condition. Because of the silty clay loam surface layer, careful management is needed to maintain a good stand of grasses and legumes. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates and pasture rotation improve the pasture.

A few areas support native hardwoods. This soil is suited to trees. Seedling mortality and the windthrow hazard are the main management concerns. Selecting a planting stock that is larger than is typical improves the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where the windthrow hazard is slight. The limitations that affect planting and harvesting are slight. In a few areas small gullies should be reshaped and seeded to grass, which can provide a protective cover until the trees are established.

This soil is suitable for building site development but generally is unsuited to onsite waste disposal. The shrink-swell potential and the wetness are limitations on sites for dwellings. The moderate depth to bedrock also is a limitation on sites for dwellings with basements, but the bedrock is soft and can be excavated. Reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations or basement walls help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry. All sanitary facilities should be connected to commercial sewers. Otherwise, sewage generally can be piped to adjacent areas that are suitable for onsite waste disposal.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IVe.

9E—Snead silty clay loam, 14 to 30 percent slopes. This moderately deep, moderately steep and steep, moderately well drained soil is on convex side slopes along upland drainageways. Individual areas are long and narrow and range from 5 to 50 acres in size.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is very dark grayish brown silty clay about 6 inches thick. The subsoil is firm silty clay about 16 inches thick. The upper part is brown, and the lower part is dark grayish brown and mottled. Weathered, gray shale bedrock is at a depth of about 30 inches. In some areas the depth to soft bedrock is more than 40 inches.

Included with this soil in mapping are small areas of the deep Armster and Greenton soils. These soils occur as narrow bands at the upper and lower edges of the mapped areas. Also included are small areas where the surface layer is lighter colored. Included areas make up about 5 to 10 percent of the unit.

Permeability is slow in the Snead soil. Surface runoff is rapid. Reaction is neutral or mildly alkaline in the subsoil. Natural fertility is low, and organic matter content is moderate. Available water capacity is low. A high seasonal water table commonly is at a depth of 2 to 3 feet during winter and spring. The shrink-swell potential is high. The surface layer is firm and can be tilled only within a narrow range in moisture content. If tilled when wet or dry, it becomes cloddy. Also, it becomes compacted if tilled when wet.

Most areas are pastured. Because of the slope, this soil is generally unsuited to cultivated crops. It is suited to shallow-rooted legumes and to cool-season bunch grasses and native warm-season grasses. A cover of pasture plants or hay is effective in controlling erosion. Pasture renovation generally is needed because most pastures are in poor condition. If the pasture is reseeded to grasses and legumes, timely tillage and tilling on the contour help to ensure more rapid growth and help to prevent the damage caused by erosion. Because of the silty clay loam surface layer, careful management is needed to maintain a good stand of grasses and legumes. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates and pasture rotation improve the pasture.

A few small areas support native hardwoods. This soil is suited to trees. The erosion hazard, the equipment limitation, the seedling mortality rate, and the windthrow hazard are management concerns. The design of logging roads and skid trails should minimize the steepness and length of the slopes. In the steepest areas, the logs should be yarded uphill to the roads or trails. Small gullies and disturbed areas should be reshaped and seeded after the trees are harvested. Selecting a planting stock that is larger than is typical improves the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where the windthrow hazard is slight.

This soil is suitable for building site development but generally is unsuited to onsite waste disposal. The shrink-swell potential, the wetness, and the slope are limitations on sites for dwellings. The moderate depth to bedrock also is a limitation on sites for dwellings with basements, but the bedrock is soft and can be excavated. Reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations or basement walls help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry. The slope can be overcome by land shaping or by designing the dwellings so that they conform to the natural slope of the land. All sanitary facilities should be connected to commercial sewers, or the sewage should be piped to adjacent areas that are better suited to onsite waste disposal.

Low strength, the potential for frost action, the shrink-swell potential, and the slope are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. The slope can be overcome by land shaping or by designing the roads and streets so that they conform to the natural slope of the land. The bedrock should be excavated in some areas.

The land capability classification is VIe.

10D—Snead-Rock outcrop complex, 5 to 14 percent slopes. This map unit occurs as areas of a moderately deep, moderately sloping and strongly sloping, moderately well drained Snead soil closely intermingled with areas where limestone crops out. It is on convex side slopes in the uplands. Individual areas range from 10 to more than 150 acres in size. They are about 65 percent Snead soil and 20 percent Rock outcrop. The Rock outcrop occurs as bands so narrow that mapping them separately from the Snead soil is not practical.

Typically, the Snead soil has a surface layer of black, firm flaggy silty clay loam about 11 inches thick. The subsoil is dark grayish brown, brown, grayish brown, and light olive brown silty clay about 11 inches thick. The substratum is grayish brown and olive brown silty clay about 16 inches thick. Soft, weathered shale bedrock is at a depth of about 38 inches. In some areas the depth to soft bedrock is more than 40 inches.

Included with this unit in mapping are small areas of the deep, somewhat poorly drained Greenton soils, the deep Nodaway soils, and the deep, poorly drained Sampsel soils. Greenton soils are downslope from the Snead soil. Nodaway soils are on narrow bottoms. Sampsel soils are lower on the side slopes than the Snead soil. Included soils make up about 10 to 15 percent of the unit.

Permeability is slow in the Snead soil. Surface runoff is medium. Reaction is slightly acid to neutral in the surface layer and neutral to moderately alkaline in the subsoil. Natural fertility is low, and organic matter content is moderate. Available water capacity is low. A seasonal high water table commonly is at a depth of 2 to 3 feet during winter and spring. The shrink-swell potential is high.

This map unit generally is unsuited to cultivated crops, pasture, and hay. Because of slope and the surface stones, cultivation is not practical and establishing grasses and legumes is very difficult.

Most areas support native hardwoods. The Snead soil is suited to trees. The stoniness, the seedling mortality rate, and the windthrow hazard are the main management concerns. Because of the stones, hand planting or direct seeding may be needed. Selecting a planting stock that is larger than is typical improves the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where the windthrow hazard is slight. Logging roads and skid trails should be carefully designed and should be established on the contour.

The Snead soil generally is unsuited to building site development and onsite waste disposal because of the stones and the depth to bedrock.

The land capability classification is VIs.

10F—Snead-Rock outcrop complex, 14 to 30 percent slopes. This map unit occurs as areas of a moderately deep, moderately steep and steep, moderately well drained Snead soil closely intermingled with areas where limestone crops out. It is on convex side slopes in the uplands. Individual areas range from 15 to 255 acres in size. They are about 60 to 70 percent Snead soil and 20 percent Rock outcrop. The Rock outcrop occurs as bands so narrow that mapping them separately from the Snead soil is not practical.

Typically, the Snead soil has a surface layer of very dark brown, friable and firm flaggy silty clay loam about 12 inches thick. The subsurface layer is very dark grayish brown, firm flaggy silty clay about 7 inches thick. The subsoil is dark grayish brown, mottled, very firm silty clay about 7 inches thick. The substratum is dark grayish brown, grayish brown, and olive brown, very firm silty clay about 12 inches thick. Soft, weathered shale bedrock is at a depth of about 38 inches. Some areas are strongly sloping.

Included with this unit in mapping are small areas of the deep, somewhat poorly drained Greenton soils. These soils are on the lower edges of the mapped areas. Also included are colluvial areas along drainageways. Included areas make up about 5 to 15 percent of the unit.

Permeability is slow in the Snead soil. Surface runoff is rapid. Reaction is neutral or mildly alkaline in the subsoil. Natural fertility is low, and organic matter content is moderate. Available water capacity is low. A seasonal high water table commonly is at a depth of 2 to 3 feet during winter and summer. The shrink-swell potential is high.

Nearly all areas are used as woodland. This soil generally is unsuited to cultivated crops and to pasture and hay because of the stones on the surface.

Most areas support native hardwoods. The Snead soil is suited to trees. The slope, the stoniness, the seedling mortality rate, and the windthrow hazard are management concerns. Because of the stones, hand planting or direct seeding generally is needed. Selecting a planting stock that is larger than is typical improves the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where the windthrow hazard is slight. Logging roads and skid trails should be carefully designed and should be established on the contour.

This map unit generally is unsuited to building site development and onsite waste disposal because of the stones, the slope, and the depth to bedrock.

The land capability classification is VIIs.

11C2—Greenton silty clay loam, 5 to 9 percent slopes, eroded. This deep, moderately sloping, somewhat poorly drained soil is on convex side slopes in the uplands. Individual areas are irregular in shape and range from 5 to more than 100 acres in size.

Typically, the surface layer is very dark grayish brown silty clay loam about 8 inches thick. The subsoil is about 41 inches thick. The upper part is dark brown, firm silty clay loam; the next part is brown and dark yellowish brown, mottled, firm silty clay loam; and the lower part is multicolored, very firm silty clay. The substratum to a depth of about 60 inches is multicolored, very firm silty clay. In some areas the dark surface layer is eroded and is less than 7 inches thick.

Included with this soil in mapping are small areas of the poorly drained Sampsel and moderately well drained Snead soils. Sampsel soils are in narrow drainageways. Snead soils are moderately deep over bedrock. They occur as narrow strips above or below the Greenton soil. Included soils make up about 5 to 10 percent of the unit.

Permeability is slow in the Greenton soil. Surface runoff is medium. Reaction ranges from moderately alkaline to medium acid in the subsoil and varies widely in the surface layer as a result of local liming practices. Organic matter content is moderately low, and natural fertility is medium. Available water capacity is high. A seasonal high water table commonly is at a depth of 1 to 3 feet during the spring. The shrink-swell potential is high. The surface layer is friable but becomes cloddy if tilled when the moisture content is high.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghum, and small grain. If cultivated crops are grown, further erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, winter cover crops, and terraces help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. This soil is suited to shallow-rooted legumes and to cool-season bunch grasses and native warm-season grasses. Overgrazing or grazing when the soil is wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing improve the pasture.

This soil is suitable for building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations or basement walls help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry.

This soil generally is unsuitable as a septic tank absorption field because of the wetness and the slow permeability. Sewage lagoons function adequately if they are established in the less sloping areas or if the site can be leveled.

Low strength, the potential for frost action, the shrink-swell potential, and the wetness are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action, shrinking and swelling, and wetness. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIIe.

11C3—Greenton silty clay loam, 5 to 9 percent slopes, severely eroded. This deep, moderately sloping, somewhat poorly drained soil is on convex side slopes and foot slopes in the uplands. Individual areas are irregular in shape and range from 10 to 50 acres in size.

Typically, the surface layer is dark brown, friable silty clay loam about 6 inches thick. The subsoil is about 31 inches thick. It is firm and mottled. It is brown and dark yellowish brown silty clay loam in the upper part and yellowish brown silty clay in the lower part. The substratum to a depth of about 60 inches is grayish brown, mottled, firm silty clay. In some areas the surface layer is very dark grayish brown. In other areas the slope is more than 9 percent.

Included with this soil in mapping are small areas of Armster, Sampsel, and Snead soils. Armster soils and the moderately deep Snead soils occur as narrow strips on the side slopes at the higher edges of the mapped areas. The poorly drained Sampsel soils are in slightly concave areas along drainageways. Included soils make up about 5 to 10 percent of the unit.

Permeability is slow in the Greenton soil. Surface runoff is rapid. Reaction is medium acid or slightly acid in the subsoil. Natural fertility is low, and organic matter content is moderately low. Available water capacity is moderate. A seasonal high water table commonly is at a depth of 1 to 3 feet during the spring. The shrink-swell potential is high. The surface layer is friable but becomes cloddy if worked when wet and crusts or puddles after hard rains.

Most areas are used as cropland. This soil is suited to small grain. It also is suited to corn and soybeans if these crops are grown only occasionally. If cultivated crops are grown, further erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, winter cover crops, and grassed waterways help to prevent excessive soil loss. Most areas can be terraced and farmed on the contour. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. This soil is suited to shallow-rooted legumes and to cool-season bunch grasses and native warm-season grasses. Overgrazing or grazing when the soil is wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and restricted use during wet periods improve the pasture.

This soil is suitable for building site development. The shrink-swell potential and wetness are limitations on sites for dwellings. Reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations or basement walls help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry.

This soil generally is unsuitable as a septic tank absorption field because of the wetness and the slow permeability. Sewage lagoons function adequately if they are established in the less sloping areas or if the site can be leveled.

Low strength, the potential for frost action, the shrink-swell potential, and the wetness are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action, shrinking and swelling, and wetness. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IVe.

11D3—Greenton silty clay loam, 9 to 14 percent slopes, severely eroded. This deep, strongly sloping, somewhat poorly drained soil is on convex foot slopes and the ends of ridges in the uplands. Individual areas are irregular in shape and range from 5 to 65 acres in size.

Typically, the surface layer is dark brown, firm silty clay loam about 5 inches thick. The subsoil is firm silty clay loam about 42 inches thick. The upper part is brown, and the lower part is dark yellowish brown, dark brown, and olive brown and has common gray mottles. The substratum to a depth of about 60 inches is dark brown and olive brown, firm silty clay.

Included with this soil in mapping are small areas of Sampsel and Snead soils. The poorly drained Sampsel soils are in slightly concave areas along drainageways. The moderately deep Snead soils occur as narrow bands on the higher edges of the mapped areas. Included soils make up about 5 to 10 percent of the unit.

Permeability is slow in the Greenton soil. Surface runoff is rapid. Reaction is medium acid or slightly acid in the subsoil. Natural fertility is low, and organic matter content is moderately low. Available water capacity is moderate. A seasonal high water table commonly is at a depth of 1 to 3 feet during the spring. The shrink-swell potential is high. The surface layer is friable but becomes cloddy if worked when wet and crusts or puddles after hard rains.

Most areas are used for pasture and hay. This soil generally is unsuited to cultivated crops. It is suited to shallow-rooted legumes and to cool-season bunch grasses and native warm-season grasses. A cover of pasture plants or hay is effective in controlling erosion. Because of the silty clay loam surface layer, careful management is needed to maintain a good stand of grasses and legumes. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and restricted use during wet periods improve the pasture.

This soil is suitable for building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations or basement walls help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry.

This soil generally is unsuitable as a septic tank absorption field because of the wetness and the slow permeability. Sewage lagoons function adequately if they are established in the less sloping areas or if the site can be leveled.

Low strength, the potential for frost action, the shrink-swell potential, and the wetness are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action, shrinking and swelling, and wetness. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is VIe.

13B—Sampsel silty clay loam, 2 to 5 percent slopes. This deep, gently sloping, poorly drained soil is on slightly concave foot slopes along drainageways. Individual areas are irregular in shape and range from 6 to about 50 acres in size.

Typically, the surface layer is black, friable silty clay loam about 7 inches thick. The subsurface layer is also black, friable silty clay loam. It is about 5 inches thick. The subsoil is firm silty clay about 38 inches thick. The upper part is very dark gray, the next part is dark grayish brown, and the lower part is grayish brown. The substratum to a depth of about 60 inches is gray, firm silty clay. In some areas soft, weathered, gray clay shale bedrock is at a depth of 40 to 60 inches.

Included with this soil in mapping are small areas of Greenton, Grundy, and Snead soils. The somewhat poorly drained Greenton soils are on the ends of ridges. The somewhat poorly drained Grundy soils are on convex ridgetops. The moderately deep Snead soils are on side slopes at the higher edges of the mapped areas. Also included, on the lower edges of the mapped areas, are Sampsel soils that are seepy and that stay wet most of the year. Included soils make up about 10 percent of the unit.

Permeability is slow in the Sampsel soil. Surface runoff is medium. Reaction ranges from medium acid to moderately alkaline in the subsoil. Natural fertility is high, and organic matter content is moderate. Available water capacity is high. A seasonal high water table commonly is within a depth of 1.5 feet during winter and spring. The shrink-swell potential is moderate in the surface soil and high in the subsoil. The surface layer can be tilled only within a narrow range of moisture content. If tilled when wet or dry, it becomes cloddy. Also, it becomes compacted if tilled when wet.

Most areas are used as cropland. This soil is suited to corn, soybeans, and grain sorghum. If cultivated crops are grown, erosion is a hazard. Also, surface compaction is a problem in seepy areas. A conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, winter cover crops, and grassed waterways help to prevent excessive soil loss. Most areas can be terraced and farmed on the contour. Constructing diversion terraces on the upper slopes helps to prevent seepage. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface compaction, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. This soil is suited to shallow-rooted legumes and to cool-season bunch grasses and native warm-season grasses. Because of the wetness and the silty clay loam surface layer, careful management is needed to maintain a good stand of grasses and legumes. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and restricted use during wet periods improve the pasture.

This soil is suitable for building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations or basement walls help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry.

This soil generally is unsuitable as a septic tank absorption field because of the wetness and the slow permeability. The depth to bedrock and the slope are limitations on sites for sewage lagoons. Onsite investigation is needed to identify suitable sites for sewage lagoons.

Low strength, the potential for frost action, the shrink-swell potential, and the wetness are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action, shrinking and swelling, and wetness. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIe.

13C—Sampsel silty clay loam, 5 to 9 percent slopes. This deep, moderately sloping, poorly drained soil is on slightly concave side slopes and foot slopes along drainageways. Individual areas generally are long and narrow and range from 5 to about 80 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 5 inches thick. The subsurface layer is also very dark gray, friable silty clay loam. It is about 4 inches thick. The subsoil extends to a depth of 60 inches or more. It is firm. The upper part is very dark gray, mottled silty clay loam; the next part is dark grayish brown, mottled silty clay and silty clay loam; and the lower part is mottled dark gray, dark grayish brown, and olive brown silty clay loam. In some areas weathered shale bedrock is within a depth of 60 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Greenton soils and the moderately deep Snead soils. Greenton soils are on the ends of ridges. Snead soils occur as narrow bands on the higher edges of the mapped areas. Also included, on the lower edges of the mapped areas, are Sampsel soils that are seepy and that stay wet most of the year. Included soils make up about 5 to 10 percent of the unit.

Permeability is slow in the Sampsel soil. Surface runoff is medium. Reaction ranges from medium acid to moderately alkaline in the subsoil. Natural fertility is medium, and organic matter content is moderate. Available water capacity is high. A seasonal high water table commonly is within a depth of 1.5 feet during winter and spring. The shrink-swell potential is moderate in the surface soil and high in the subsoil. The surface layer can be tilled only within a narrow range in moisture content. If tilled when wet or dry, it becomes cloddy. Also, it becomes compacted if tilled when wet. The seepy areas stay wet most of the year.

Most areas are used as cropland. This soil is suited to corn, soybeans, grain sorghum, and small grain. If cultivated crops are grown, erosion is a hazard. Also, surface compaction is a problem in seepy areas. A conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, winter cover crops, and grassed waterways help to prevent excessive soil loss. Most areas can be terraced and farmed on the contour. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface compaction, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. This soil is suited to shallow-rooted legumes and to cool-season bunch grasses and native warm-season grasses. Because of the wetness and the silty clay loam surface layer, careful management is needed to maintain a good stand of grasses and legumes. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and restricted use during wet periods improve the pasture.

This soil is suitable for building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations or basement walls help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry.

This soil generally is unsuitable as a septic tank absorption field because of the wetness and the slow permeability. The depth to bedrock and the slope are limitations on sites for sewage lagoons. Onsite investigation is needed to identify sites where the soil is deep enough for sewage lagoons. Also, the site should be leveled.

Low strength, the potential for frost action, the shrink-swell potential, and the wetness are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action, shrinking and swelling, and wetness. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIIe.

24B—Lagonda silt loam, 2 to 5 percent slopes. This deep, gently sloping, somewhat poorly drained soil is on the ends of ridges and in low saddles in the uplands. Individual areas are irregular in shape and range from 5 to 25 acres in size.

Typically, the surface layer is very dark gray, friable silt loam about 6 inches thick. The subsurface layer is very dark gray, friable silty clay loam about 9 inches thick. The subsoil is about 40 inches thick. It is mottled and firm. The upper part is dark grayish brown silty clay, and the lower part is grayish brown silty clay loam. The substratum to a depth of about 60 inches is mottled gray, brown, and yellowish brown, firm silty clay loam. In some areas the lower part of the subsoil contains less sand.

Included with this soil in mapping are small areas of the moderately well drained Sharpsburg soils. These soils are on narrower, slightly higher ridges. They make up less than 5 percent of the unit.

Permeability is slow in the Lagonda soil. Surface runoff is medium in cultivated areas. Reaction ranges from medium acid to neutral in the subsoil and varies in the surface layer because of local liming practices. Natural fertility is high, and organic matter content is moderate. Available water capacity is high. A seasonal high water table commonly is at a depth of 1.5 to 3.0 feet during winter and spring. The shrink-swell potential is high. The surface layer is friable. It becomes cloddy, however, if tilled when wet. Also, it can crust or puddle, especially after hard rains.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, small grain, and grain sorghum. If cultivated crops are grown, erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, and winter cover crops help to prevent excessive soil loss. In a few areas slopes are long enough for terracing and contour farming. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. This soil is suited to shallow-rooted legumes and to cool-season grasses and native warm-season grasses. Overgrazing or grazing when the soil is wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods improve the pasture.

This soil is suitable for building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations or basement walls help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry.

This soil generally is unsuitable as a septic tank absorption field because of the slow permeability and the wetness. The slope is a limitation on sites for sewage lagoons. It generally can be overcome, however, by leveling the site.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIe.

25C2—Lagonda silty clay loam, 5 to 9 percent slopes, eroded. This deep, moderately sloping, somewhat poorly drained soil is on slightly concave side slopes in the uplands. Individual areas are irregular in shape and range from 10 to 150 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 6 inches thick. The subsurface layer is very dark gray, firm silty clay loam about 3 inches thick. The subsoil extends to a depth of 60 inches or more. It is mottled and firm. The upper part is dark grayish brown silty clay, and the lower part is grayish brown clay and clay loam. In some severely eroded areas, the surface layer is dark grayish brown silty clay loam. In several small areas the lower part of the subsoil contains less sand.

Permeability is slow. Surface runoff is medium in cultivated areas. Reaction ranges from medium acid to neutral in the subsoil and varies in the surface layer because of local liming practices. Natural fertility is medium, and organic matter content is moderately low. Available water capacity is high. A seasonal high water table commonly is at a depth of 1.5 to 3.0 feet during winter and spring. The shrink-swell potential is high. The surface layer is friable but can be easily tilled only within a somewhat narrow range in moisture content. It becomes cloddy if tilled when wet. Also, it tends to crust or puddle after hard rains, especially in areas where the plow layer contains subsoil material.

Most areas are used for cultivated crops. This soil is suited to corn, grain sorghum, soybeans, and small grain. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, crop rotations that include grasses and legumes, winter cover crops, and grassed waterways help to prevent excessive soil loss. Most areas can be terraced and farmed on the contour. Special management is needed if the clayey subsoil is exposed when terraces are constructed. The subsoil cannot be easily tilled and is lower in fertility and available water capacity than the surface soil. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. This soil is suited to shallow-rooted legumes and to cool-season bunch grasses and native warm-season grasses. Overgrazing or grazing when the soil is wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods improve the pasture.

This soil is suitable for building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations or basement walls help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry.

This soil generally is unsuitable as a septic tank absorption field. The slope is a limitation on sites for sewage lagoons. It generally can be overcome, however, by leveling the site.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIIe.

25D2—Lagonda silty clay loam, 9 to 14 percent slopes, eroded. This deep, strongly sloping, somewhat poorly drained soil is on slightly concave slopes at the head of upland drainageways. Individual areas are irregular in shape and range from 5 to 75 acres in size.

Typically, the surface layer is black, friable silty clay loam about 8 inches thick. The subsoil extends to 60 inches or more. The upper part is very dark gray, firm silty clay loam; the next part is dark grayish brown, mottled, very firm silty clay; and the lower part is dark grayish brown, mottled, firm silty clay loam and clay loam. In some areas the subsoil is clay loam below a depth of 20 inches.

Permeability is slow in the Lagonda soil. Surface runoff is rapid in cultivated areas. Reaction ranges from medium acid to neutral in the subsoil and varies in the surface layer because of local liming practices. Natural fertility is medium, and organic matter content is moderately low. Available water capacity is high. A seasonal high water table commonly is at a depth of 1.5 to 3.0 feet during winter and spring. The shrink-swell potential is high. The surface layer is friable but can be easily tilled only within a somewhat narrow range in moisture content. It becomes cloddy if tilled when wet. Also, it tends to crust or puddle after hard rains, especially in areas where the plow layer contains subsoil material.

Most areas are used for pasture and hay. Some are cultivated. Because of the slope and the hazard of further erosion, this soil generally is unsuited to cultivated crops. It is suited to shallow-rooted legumes and to cool-season bunch grasses and native warm-season grasses. A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods improve the pasture.

This soil is suitable for building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations or basement walls help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry.

This soil generally is unsuitable as a septic tank absorption field. The slope is a limitation on sites for sewage lagoons. It generally can be overcome, however, by leveling the site.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is VIe.

26B—Ladoga silt loam, 2 to 5 percent slopes. This deep, moderately well drained, gently sloping soil is on convex ridgetops in the uplands. Areas generally are long and narrow and range from about 5 to more than 20 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is dark grayish brown silt loam about 4 inches thick. The subsoil is firm silty clay loam about 45 inches thick. The upper part is dark yellowish brown, the next part is dark yellowish brown and mottled, and the lower part is yellowish brown and mottled. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm silty clay loam. In some eroded areas the subsurface layer has been incorporated into the surface layer. In some small areas the dark surface layer is more than 10 inches thick.

Permeability is moderately slow. Surface runoff is medium. Reaction is medium acid or strongly acid in the most acid part of the soil. Natural fertility is high, and organic matter content is moderate. Available water capacity is high. The shrink-swell potential is moderate. The surface layer is friable and can be easily worked, but it tends to crust or puddle after hard rains.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghum, and small grain. If cultivated crops are grown, erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, winter cover crops, and grassed waterways help to prevent excessive soil loss. Most areas can be terraced and farmed on the contour. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. This soil is suited to alfalfa, bromegrass, and most other grasses and legumes. Overgrazing or grazing when the soil is wet, however, damages the stand and causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing improve the pasture.

A few small areas support native hardwoods. This soil is suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed by proper site preparation and by prescribed burning, spraying, or cutting. No other hazards or limitations affect planting or harvesting.

This soil is suited to building site development and to some kinds of onsite waste disposal. The shrink-swell potential is a limitation on sites for dwellings. Adequately reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. Septic tank absorption fields do not function properly because of the moderately slow permeability. Slope and seepage are limitations on sites for sewage lagoons. Grading helps to level the site. Providing slowly permeable material helps to seal the lagoon and thus helps to prevent seepage.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIe.

26C2—Ladoga silt loam, 5 to 9 percent slopes, eroded. This deep, moderately well drained, moderately sloping soil is on narrow ridgetops and side slopes in the uplands. Individual areas generally are rectangular and range from 5 to 30 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsoil is firm silty clay loam about 46 inches thick. The upper part is brown, the next part is dark yellowish brown, and the lower part is dark yellowish brown and mottled. The substratum to a depth of about 60 inches is yellowish brown, mottled, friable silt loam. In places, erosion has removed all of the original surface layer and the plow layer is dark grayish brown silty clay loam. In some areas the subsoil is clay loam. In other areas the dark surface layer is more than 10 inches thick.

Permeability is moderately slow. Surface runoff is medium. Reaction is medium acid or strongly acid in the most acid part of the soil. Natural fertility is medium, and organic matter content is low. Available water capacity is high. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled, but it tends to crust or puddle after hard rains.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and grain sorghum. If cultivated crops are grown, further erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, winter cover crops, and grassed waterways help to prevent excessive soil loss. Most areas are long and smooth enough for terracing and contour farming. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration.

A cover of hay or pasture plants is effective in controlling erosion. This soil is suited to alfalfa, bromegrass and most other grasses and legumes. Overgrazing or grazing when the soil is wet, however, damages the stand and causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing improve the pasture.

A few small areas support native hardwoods. This soil is suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed by proper site preparation and by spraying or cutting. No other hazards or limitations affect planting or harvesting.

This soil is suited to building site development and to some kinds of onsite waste disposal. The shrink-swell potential is a limitation on sites for dwellings and small commercial buildings. Also, the slope is a limitation on sites for small commercial buildings. It can be overcome, however, by land shaping. Adequately reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. Septic tank absorption fields do not function properly because of the moderately slow permeability. Slope and seepage are limitations on sites for sewage lagoons. Providing slowly permeable material helps to seal the lagoon and thus helps to prevent seepage. The slope can be overcome by leveling the site or by selecting the less sloping areas as sites for the lagoons.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIIe.

26D2—Ladoga silt loam, 9 to 14 percent slopes, eroded. This deep, moderately well drained, strongly sloping soil is on convex side slopes in the uplands. Individual areas generally are long and narrow and range from 5 to 25 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsoil is firm silty clay loam about 45 inches thick. The upper part is brown, the next part is dark yellowish brown, and the lower part is dark yellowish brown and mottled. The substratum to a depth of about 60 inches is yellowish brown, mottled, friable silt loam. In some areas, erosion has removed most of the original surface layer and the plow layer is dark grayish brown silty clay loam. In some areas the slope is less than 9 percent.

Included with this soil in mapping are small areas of the moderately deep Snead soils. These soils are lower on the side slopes than the Ladoga soil. Also, they have a thicker dark surface layer. They make up less than 5 percent of the unit.

Permeability is moderately slow in the Ladoga soil. Surface runoff is rapid. Reaction is medium acid or strongly acid in the most acid part of the soil. Natural fertility is medium, and organic matter content is low. Available water capacity is high. The shrink-swell potential is moderate. The surface layer is friable and can be tilled throughout a moderately wide range in moisture content. It becomes cloddy, however, if tilled when wet and crusts or puddles after hard rains.

Most areas are used for pasture, hay, or woodland. A few are used for cultivated crops. This soil is suited to corn, soybeans, small grain, and grain sorghum. If cultivated crops are grown, further erosion is a hazard. Diversion terraces, a conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, winter cover crops, and grassed waterways help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. This soil is suited to alfalfa, bromegrass, and most other grasses and legumes. Overgrazing or grazing when the soil is wet, however, damages the stand and causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing improve the pasture.

A few small areas support native hardwoods. This soil is suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed by proper site preparation and by spraying or cutting. No other hazards or limitations affect planting or harvesting.

This soil is suited to building site development and some kinds of onsite waste disposal. The shrink-swell potential and the slope are limitations on sites for dwellings and small commercial buildings. Adequately reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The slope can be overcome by land shaping or by designing the buildings so that they conform to the natural slope of the land. Septic tank absorption fields do not function properly because of the moderately slow permeability. Slope and seepage are limitations on sites for sewage lagoons. Providing slowly permeable material helps to seal the lagoon and thus helps to prevent seepage. The slope can be overcome by leveling the site or by selecting the less sloping areas as sites for the lagoons.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIIe.

27D3—Ladoga silty clay loam, 5 to 14 percent slopes, severely eroded. This deep, moderately sloping and strongly sloping, moderately well drained soil is on side slopes in the uplands. Individual areas generally are long and narrow and range from 5 to 25 acres in size.

Typically, the surface layer is dark brown, friable silty clay loam about 4 inches thick. The subsoil is firm silty clay loam about 50 inches thick. The upper part is brown, and the lower part is yellowish brown and dark yellowish brown and is mottled. The substratum to a depth of about 60 inches is yellowish brown, mottled, friable silt loam. In some areas the surface layer is very dark grayish brown silt loam. In other areas the subsoil has a considerable amount of sand and fine gravel.

Included with this soil in mapping are small areas of the moderately deep Snead soils. These soils are lower on the side slopes than the Ladoga soil. They make up less than 5 percent of the unit.

Permeability is moderately slow in the Ladoga soil. Surface runoff is rapid. Reaction is medium acid or strongly acid in the subsoil. Natural fertility and organic matter content are low. Available water capacity is high. The shrink-swell potential is moderate. Because of the content of clay in the surface layer, tillage should be carefully timed. If this layer is tilled when wet, it becomes cloddy. Also, it crusts or puddles after hard rains.

Most areas are used for pasture and hay. Some of the less sloping areas are used for soybeans and grain sorghum. This soil is suited to cultivated crops if the crops are grown on a limited basis, if proper tillage methods are used, and if the cropping sequence includes close-growing pasture or hay crops. If cultivated crops are grown, further erosion is a hazard. Diversion terraces, crop rotations that include grasses and legumes, winter cover crops, and grassed waterways help to prevent excessive soil loss. A conservation tillage system that leaves protective amounts of crop residue on the surface or regular additions of other organic material help to control erosion, improve fertility, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. This soil is suited to alfalfa, bromegrass, and most other grasses and legumes. Overgrazing or grazing when the soil is wet, however, damages the stand and causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing improve the pasture.

This soil is suited to trees, but only a few areas are wooded. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed by proper site preparation and by prescribed burning, spraying, or cutting. No other hazards or limitations affect planting or harvesting.

This soil is suited to building site development and some kinds of onsite waste disposal. The shrink-swell potential and the slope are limitations on sites for dwellings and small commercial buildings. Adequately reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The slope can be overcome by land shaping or by designing the buildings so that they conform to the natural slope of the land. Septic tank absorption fields do not function properly because of the moderately slow permeability. Slope and seepage are limitations on sites for sewage lagoons. Providing slowly permeable material helps to seal the lagoon and thus helps to prevent seepage. The slope can be overcome by leveling the site or by selecting the less sloping areas as sites for the lagoons.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IVe.

31—Colo silty clay loam. This deep, nearly level, poorly drained soil is on flood plains along the tributaries of the Missouri River. It is occasionally flooded for brief periods. Individual areas are long and narrow and range from 50 to 400 acres in size.

Typically, the surface layer is black, friable silty clay loam about 6 inches thick. The subsurface layer is firm silty clay loam about 22 inches thick. The upper part is black, and the lower part is very dark gray. The subsoil is very dark gray, firm, mottled silty clay loam about 20 inches thick. The substratum to a depth of about 60 inches is very dark gray, firm, mottled silty clay loam. In some areas the subsurface layer contains more clay.

Included with this soil in mapping are small areas of the moderately well drained Nodaway soils. These soils contain more silt than the Colo soil. They are in areas between the Colo soil and the stream channels. Also included are several small scattered areas of Colo soils that are subject to ponding. Included soils make up less than 5 percent of the unit.

Permeability is moderate in the Colo soil. Surface runoff is slow. Reaction is slightly acid or neutral in the subsoil. Natural fertility and organic matter content are high. Available water capacity also is high. A seasonal high water table commonly is at a depth of 1 to 3 feet during winter and spring. The shrink-swell potential is high. The surface layer is friable but can become compacted and cloddy if it is tilled when wet.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and small grain. The flooding is a hazard, but open ditches, shallow surface drains, and land grading help to remove the excess water quickly. Levees also help to control the floodwater. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to keep the surface layer friable, and increases the rate of water infiltration.

This soil is suited to shallow-rooted legumes and cool-season bunch grasses for pasture and hay. The grasses and legumes can drown out during periods of flooding. Land grading and shallow surface drains, however, remove the excess surface water. Because of the silty clay loam surface layer and the wetness, careful management is needed. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, and restricted use during wet periods improve the pasture.

This soil generally is unsuited to building site development and onsite waste disposal because of the occasional flooding.

The land capability classification is IIw.

33—Zook silty clay loam. This deep, nearly level, poorly drained soil is in moderately wide, low areas on flood plains. It is occasionally flooded for brief periods, generally in spring and late in fall. Individual areas are irregular in shape and range from 30 to more than 300 acres in size.

Typically, the surface layer is black, firm silty clay loam about 6 inches thick. The subsurface layer is black and very dark gray, firm silty clay loam about 31 inches thick. The subsoil is dark gray, firm silty clay loam about 13 inches thick. The substratum to a depth of about 66 inches is mottled dark gray and dark grayish brown, firm silty clay loam. In some areas the upper part of the surface layer is very dark grayish brown silt loam, which was recently deposited. In other areas the subsurface layer and subsoil contain less clay.

Included with this soil in mapping are small areas of the moderately well drained Nodaway soils on natural levees along the stream channels. These soils make up less than 5 percent of the unit.

Permeability is slow in the Zook soil. Surface runoff is very slow. Reaction ranges from medium acid to neutral in the subsoil and varies in the surface layer as a result of local liming practices. Natural fertility is high, and organic matter content is high. Available water capacity is high. A seasonal high water table commonly is at a depth of 1 to 3 feet during winter and spring. The shrink-swell potential is high. The surface layer is sticky when wet and cloddy when dry. As a result, careful timing of tillage is needed.

Nearly all of the acreage is used for cultivated crops. Only a few isolated areas are used for pasture and hay. This soil is suited to soybeans, corn, grain sorghum, and small grain. The wetness is the main limitation. Crops in depressional areas may drown out. Land grading, shallow surface drains, and open ditches help to remove excess water. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

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

The land capability classification is IIw.

35—Booker silty clay. This deep, nearly level, very poorly drained soil is in broad areas on the flood plain along the Missouri River. It is protected by levees but is still occasionally flooded by overflow from local tributaries or because of levee breaks. It commonly is ponded after heavy rains. Individual areas are irregular in shape and range from about 100 to 1,500 acres in size.

Typically, the surface layer is black and very dark gray, firm silty clay about 9 inches thick. The subsurface layer is black silty clay about 10 inches thick. The subsoil is mottled, very firm clay about 17 inches thick. The upper part is very dark gray, and the lower part is very dark grayish brown. The substratum to a depth of about 60 inches is dark grayish brown and gray, mottled, very firm clay. In some areas the surface layer is recently deposited silty clay loam.

Included with this soil in mapping are small areas of Levasy and Norborne soils. The poorly drained Levasy soils are slightly higher on the landscape than the Booker soil. They typically are silty clay in the upper 20 to 38 inches and are underlain by loamy material. The well drained Norborne soils are on natural levees. Included soils make up about 10 percent of the unit.

Permeability is very slow in the Booker soil. Surface runoff is very slow or ponded. Reaction is medium acid or slightly acid in the subsoil. Natural fertility is medium, and organic matter content is moderate. Available water capacity is moderate. A seasonal water table commonly is 0.5 foot above the surface to 1.0 foot below during winter and spring. The shrink-swell potential is very high.

The surface layer is high in content of clay and can be tilled only within a very narrow range in moisture content. It puddles and crusts after hard rains. Root development is restricted by poor aeration.

Nearly all of the acreage is used for cultivated crops. This soil is suited to soybeans, corn, and small grain. It is best suited to the row crops that require a short growing season. The wetness is the main limitation affecting cultivated crops. Measures that intercept the runoff from adjacent hillsides, land grading, shallow surface drains, and open ditches quickly remove the excess water. A conservation tillage system that leaves crop residue on the surface helps to prevent surface compaction. Returning crop residue to the soil or regularly adding other organic material helps to prevent surface crusting, improves fertility, and increases the rate of water infiltration. Plowing in the fall improves tilth for the crops grown the following spring.

This soil is suited to trees. The equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. The use of equipment should be limited to periods when the surface is dry or frozen. Ridging the soil and planting larger stock than is typical on the ridges improve the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where the windthrow hazard is slight. Thorough site preparation, which may include spraying or cutting, helps to control plant competition.

This soil generally is unsuited to building site development and most kinds of onsite waste disposal because of the occasional flooding and the ponding.

The land capability classification is IIIw.

36—Bremer silt loam. This deep, nearly level, poorly drained soil is on low terraces along the smaller streams. It is occasionally flooded. Individual areas generally are long and narrow and range from 5 to more than 60 acres in size.

Typically, the surface layer is black, friable silt loam about 6 inches thick. The subsurface layer is black, firm silty clay loam about 8 inches thick. The subsoil is mottled, firm silty clay loam about 36 inches thick. The upper part is very dark gray, the next part is dark gray, and the lower part is gray. The substratum to a depth of about 60 inches is gray, mottled silty clay loam. In some areas the surface layer is recently deposited very dark grayish brown silt loam. In other areas it is silty clay loam. In places the black upper part of the soil is less than 24 inches thick.

Included with this soil in mapping are small areas of Colo and Nodaway soils, which occur as narrow strips along the smaller drainageways. Colo soils contain more clay in the subsoil than the Bremer soil. Nodaway soils are silty throughout. Included soils make up 2 to 5 percent of the unit.

Permeability is moderately slow in the Bremer soil. Surface runoff is slow. The soil generally is slightly acid throughout, but the surface layer ranges from medium acid to neutral, depending on local liming practices. Natural fertility and organic matter content are high. Available water capacity also is high. A seasonal high water table commonly is at a depth of 1 to 2 feet during winter and spring. The shrink-swell potential is moderate in the surface layer and high in the subsoil and substratum. The surface layer is friable. It becomes cloddy, however, if tilled when wet. Also, it crusts or puddles, especially after hard rains.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghum, and small grain. If cultivated crops are grown, artificial drainage is needed in depressional areas. Land grading, shallow surface drains, and open ditches help to remove the excess water. Diversion terraces may be needed to intercept the runoff from the uplands. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is suited to trees. The equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. The use of equipment should be limited to periods when the surface is dry or frozen. Ridging the soil and planting larger stock than is typical on the ridges improve the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where the windthrow hazard is slight. Thorough site preparation, which may include spraying or cutting, helps to control plant competition.

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

The land capability classification is IIw.

37—Moniteau silt loam. This deep, nearly level, poorly drained soil is on low stream terraces. It is subject to rare flooding. Individual areas are long and narrow and range from 20 to more than 150 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsurface layer is grayish brown, friable silt loam about 9 inches thick. The subsoil is grayish brown and light brownish gray, mottled, firm silty clay loam about 43 inches thick. The substratum to a depth of about 64 inches is light brownish gray, mottled, firm silty clay loam. In some areas it is very dark grayish brown.

Included with this soil in mapping are small areas of the moderately well drained Nodaway soils along the smaller streams. These soils make up about 5 percent of the unit.

Permeability is moderately slow in the Moniteau soil. Surface runoff is slow. Reaction ranges from medium acid to very strongly acid in the subsoil and varies widely in the surface layer as a result of local liming practices. Natural fertility is medium, and organic matter content is moderately low. Available water capacity is high. A seasonal high water table commonly is within a depth of 1 foot during winter and spring. The shrink-swell potential is moderate in the subsoil and substratum. The surface layer is friable and can be easily worked throughout a fairly wide range in moisture content. It tends to crust or puddle, however, after hard rains.

Most areas are used for pasture and hay. A small acreage is used for cultivated crops or trees. This soil is suited to corn, soybeans, grain sorghum, and small grain. The wetness is the main limitation affecting cultivated crops. It can be reduced by diversion of the runoff from the uplands, shallow surface drains, and tile drainage. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is suited to shallow-rooted legumes and cool-season bunch grasses for pasture and hay. Overgrazing or grazing when the soil is wet, however, causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods improve the pasture.

A few small areas support native hardwoods. This soil is suited to trees. Plant competition, the equipment limitation, seedling mortality, and the windthrow hazard are management concerns. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed by proper site preparation and by spraying, or cutting. Because of the wetness, the use of equipment should be limited to periods when the surface is dry or frozen. Ridging the soil and planting on the ridges improves the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where the windthrow hazard is slight.

This soil generally is unsuited to building site development and most kinds of onsite waste disposal because of the flooding and the wetness.

The land capability classification is IIIw.

38—Wiota silt loam. This deep, nearly level, well drained soil is on stream terraces along tributaries of the Missouri River. It is subject to rare flooding. Individual areas are irregular in shape and range from 10 to 40 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsurface layer also is very dark grayish brown, friable silt loam. It is about 5 inches thick. The subsoil is friable silty clay loam about 37 inches thick. The upper part is dark brown, and the lower part is brown. The substratum to a depth of about 60 inches is brown, mottled, friable silty clay loam.

Included with this soil in mapping are small areas of Bremer and Nodaway soils. The poorly drained Bremer soils are slightly lower on the landscape than the Wiota soil. Also, they contain more clay. Nodaway soils are stratified and are on flood plains. Included soils make up about 5 percent of the unit.

Permeability is moderate in the Wiota soil. Surface runoff is medium. Reaction ranges from slightly acid to strongly acid in the surface layer. Natural fertility is high, and organic matter content is moderate. Available water capacity is very high. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content.

Most areas are used for cultivated crops. A small acreage is used for pasture and hay. This soil is suited to corn, soybeans, small grain, and grain sorghum. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is suited to alfalfa, smooth bromegrass, and other grasses and legumes for pasture and hay. Overgrazing or grazing when the soil is wet, however, causes surface compaction and poor tilth and reduces the rate of water infiltration. Proper stocking rates and pasture rotation improve the pasture.

This soil generally is unsuitable for building site development and most kinds of onsite waste disposal because of the flooding.

The land capability classification is I.

39—Nodaway silt loam. This deep, nearly level, moderately well drained soil is on flood plains or alluvial fans along tributary streams of the Missouri River. It is occasionally flooded in spring and late in fall. Individual areas are broad and irregularly shaped and range from 50 to 200 acres in size.

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

Included with this soil in mapping are small areas of the poorly drained Bremer, Colo, and Zook soils. These soils have a higher content of clay than the Nodaway soil. Bremer soils are on low terraces. Colo and Zook soils are in the slightly lower areas between the Nodaway soil and the uplands. Included soils make up about 10 percent of the unit.

Permeability is moderate in the Nodaway soil. Surface runoff is slow. Reaction is slightly acid or neutral in the substratum. Natural fertility is high, and organic matter content is moderate. Available water capacity is very high. A seasonal high water table is at a depth of 3 to 5 feet in spring and early in summer. The shrink-swell potential is moderate. The surface layer can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghum, and small grain, but the short periods of flooding can be a problem. If cultivated crops are grown, the flooding delays tillage in the spring of some years. Fall plowing increases the susceptibility of the soil to scouring by floodwater.

This soil is suited to hay and pasture. The flooding is not a serious problem because it usually lasts for short periods. Applications of fertilizer, proper stocking rates, pasture rotation, and restricted use during wet periods improve the pasture.

A few areas support native trees. This soil is suited to trees. Cuttings and seedlings survive and grow well if competing vegetation is controlled or removed by proper site preparation and by spraying or cutting. No other hazards or limitations affect harvesting or planting.

This soil generally is unsuited to building site development and onsite waste disposal because of the occasional flooding.

The land capability classification is IIw.

41C2—Armster loam, 5 to 9 percent slopes, eroded. This deep, moderately sloping, moderately well drained soil is on convex side slopes and narrow ridgetops in the uplands. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 6 inches thick. The subsoil is about 46 inches thick. The upper part is brown, friable clay loam; the next part is brown, firm clay loam mottled with reddish brown; and the lower part is brown, dark yellowish brown, and yellowish brown, mottled, firm sandy clay and sandy clay loam. The substratum to a depth of about 60 inches is multicolored, firm sandy clay loam. In some areas on narrow ridgetops, the slope is less than 5 percent and the soil is little affected by erosion.

Included with this soil in mapping are small areas of Lagonda and Sharpsburg soils. Lagonda soils are somewhat poorly drained and are at the head of drainageways. Sharpsburg soils contain less sand throughout than the Armster soil and have a thicker dark surface layer. They occur as narrow strips along the upper boundary of the mapped areas. Included soils make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Armster soil. Surface runoff is medium. Reaction ranges from very strongly acid to neutral in the subsoil. Natural fertility is medium, and organic matter content is moderately low. Available water capacity is high. A seasonal high water table commonly is at a depth of 3 to 5 feet during winter and spring. The shrink-swell potential is high. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. It tends to crust or puddle, however, after hard rains, especially in plowed areas where it contains subsoil material.

Most areas are used for cultivated crops. A small acreage is used for pasture and hay or for woodland. This soil is suited to corn, soybeans, small grain, and grain sorghum. If cultivated crops are grown, further erosion is a hazard. Properly designed terraces and grassed waterways, a conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, and winter cover crops help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to prevent surface crusting.

A cover of pasture plants or hay is effective in controlling erosion. This soil is suited to alfalfa and bromegrass. Overgrazing or grazing when the soil is wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates and pasture rotation improve the pasture.

A few areas support native hardwoods. This soil is suited to trees. No hazards or limitations affect planting or harvesting.

This soil is suitable for building site development. The shrink-swell potential is a limitation on sites for dwellings. Also, the wetness is a limitation on sites for dwellings with basements. Reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations or basement walls help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry.

This soil generally is unsuitable as a septic tank absorption field unless a properly constructed mound system can be used to overcome the wetness and the moderately slow permeability. Sewage lagoons function adequately if the site can be leveled and the berms and bottom of the lagoon are sealed with slowly permeable material, which helps to prevent the contamination of the ground water. Also, waste generally can be piped to adjacent areas that are suitable for sewage lagoons.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIIe.

41D2—Armster loam, 9 to 14 percent slopes, eroded. This deep, strongly sloping, moderately well drained soil is on convex side slopes in the uplands. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 6 inches thick. The subsoil to a depth of 60 inches or more is firm clay loam. It is brown in the upper part, strong brown in the next part, and strong brown and mottled in the lower part. The surface layer is dark yellowish brown clay loam in areas where plowing has mixed it with the upper part of the subsoil. In some areas the slope is less than 9 percent.

Included with this soil in mapping are small areas of the somewhat poorly drained Lagonda soils at the head of drainageways. Also included are areas of the moderately deep Snead soils and some areas of Rock outcrop on the lower parts of the side slopes. Included areas make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Armster soil. Surface runoff is medium. Reaction ranges from slightly acid to very strongly acid in the upper part of the subsoil and from slightly acid to mildly alkaline in the lower part. Natural fertility is medium, and organic matter content is moderately low. Available water capacity is high. A seasonal high water table commonly is at a depth of 3 to 5 feet during winter and spring. The shrink-swell potential is high. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. It tends to crust or puddle, however, after hard rains, especially in plowed areas where it contains subsoil material.

Most areas are used for pasture and hay. A small acreage is used for soybeans and grain sorghum. This soil is suited to cultivated crops grown on a limited basis in rotation with close-growing pasture or hay crops. If cultivated crops are grown, further erosion is a hazard. Properly designed terraces and grassed waterways, a conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, and winter cover crops help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. This soil is suited to alfalfa and bromegrass. Overgrazing or grazing when the soil is wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing improve the pasture.

A few areas support native hardwoods. This soil is suited to trees. No hazards or limitations affect planting or harvesting.

This soil is suitable for building site development. The shrink-swell potential is a limitation on sites for dwellings. Also, the wetness is a limitation on sites for dwellings with basements. Reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations or basement walls help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry.

This soil generally is unsuitable as a septic tank absorption field unless a properly constructed mound system can be used to overcome the wetness and the moderately slow permeability. Sewage lagoons function adequately if the site can be leveled and the berms and bottom of the lagoon are sealed with slowly permeable material, which helps to prevent the contamination of the ground water. Also, waste generally can be piped to adjacent areas that are suitable for sewage lagoons.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IVe.

42C3—Armster clay loam, 5 to 9 percent slopes, severely eroded. This deep, moderately sloping, moderately well drained soil is on narrow ridgetops and convex side slopes in the uplands. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is dark brown, friable clay loam about 5 inches thick. The subsoil to a depth of 60 inches or more is firm clay loam. It is brown in the upper part, strong brown in the next part, and yellowish brown and mottled in the lower part. In some areas the surface layer is loam or silt loam. In several small areas the subsoil is silty clay loam.

Included with this soil in mapping are small areas of Lagonda and Sharpsburg soils. The somewhat poorly drained Lagonda soils are at the head of drainageways. Sharpsburg soils have a thick, black surface layer. They are on ridgetops above the Armster soil. Included soils make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Armster soil. Surface runoff is rapid. Reaction ranges from slightly acid to very strongly acid in the upper part of the subsoil and from slightly acid to mildly alkaline in the lower part. Natural fertility is low, and organic matter content is low. Available water capacity is high. A seasonal high water table commonly is at a depth of 3 to 5 feet during winter and spring. The shrink-swell potential is high. The surface layer is high in content of clay and can be easily worked only within a narrow range in moisture content.

Most areas are used for cultivated crops, pasture, or hay. This soil is suited to cultivated crops if the crops are grown on a limited basis in rotation with close-growing pasture or hay crops. If cultivated crops are grown, further erosion is a hazard. Properly designed terraces and grassed waterways, a conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, and winter cover crops help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is suited to most grasses and legumes for pasture and hay. A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing improve the pasture.

This soil is suited to trees. No hazards or limitations affect planting or harvesting.

This soil is suitable for building site development. The shrink-swell potential is a limitation on sites for dwellings. Also, the wetness is a limitation on sites for dwellings with basements. Reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations or basement walls help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry.

This soil generally is unsuitable as a septic tank absorption field unless a properly constructed mound system can be used to overcome the wetness and the moderately slow permeability. Sewage lagoons function adequately if the site can be leveled and the berms and bottom of the lagoon are sealed with slowly permeable material, which helps to prevent the contamination of the ground water. Also, waste generally can be piped to adjacent areas that are suitable for sewage lagoons.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IVe.

42E3—Armster clay loam, 9 to 20 percent slopes, severely eroded. This deep, strongly sloping and moderately steep, moderately well drained soil is on convex side slopes in the uplands. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is dark brown, friable clay loam about 5 inches thick. The subsoil to a depth of 60 inches or more is clay loam. It is dark brown and friable in the upper part, and yellowish red and firm in the next part, and strong brown, mottled, and firm in the lower part. In some uneroded areas the surface layer is very dark grayish brown loam.

Included with this soil in mapping are small areas of the nearly level Nodaway soils in narrow drainageways, the somewhat poorly drained Lagonda soils at the head of drainageways, and the moderately deep Snead soils, which occur as narrow bands on the lower parts of the landscape. Nodaway soils are silty throughout. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Armster soil. Surface runoff is rapid. Reaction ranges from slightly acid to very strongly acid in the upper part of the subsoil and from slightly acid to mildly alkaline in the lower part. Natural fertility and organic matter content are low. Available water capacity is high. A seasonal high water table commonly is at a depth of 3 to 5 feet during winter and spring. The surface layer has a high content of clay and can be easily worked only within a very narrow range in moisture content.

Most areas are used for pasture and hay. This soil generally is unsuited to cultivated crops because of the slope and the erosion. It is suited to pasture and hay. A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is wet, however, causes surface compaction and excessive runoff and increases the susceptibility to erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing improve the pasture.

This soil is suited to trees. The erosion hazard, the equipment limitation, and the seedling mortality rate are the main management concerns. The design of logging roads and skid trails should minimize the steepness and length of the slopes. The roads and trails should be established on the contour. In the steepest areas, the logs should be yarded uphill to the roads or trails. Disturbed areas should be seeded after the trees are harvested. Hand planting and selecting a planting stock that is larger than is typical improve the seedling survival rate.

This soil is suitable for building site development, but it has severe limitations as a site for sanitary facilities. The shrink-swell potential and the slope are limitations on sites for dwellings. Also, the wetness is a limitation on sites for dwellings with basements. Reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations or basement walls help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry. The slope can be overcome by land shaping or by designing the dwellings so that they conform to the natural slope of the land. Sewage can be piped to adjacent areas that are better suited to onsite waste disposal.

Low strength, the potential for frost action, the shrink-swell potential, and the slope are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. The roads and streets should be designed so that they conform to the natural slope of the land.

The land capability classification is VIe.

54C2—Knox silt loam, 5 to 9 percent slopes, eroded. This deep, well drained, moderately sloping soil is on ridgetops and the upper side slopes in the uplands. Individual areas typically are long and narrow and range from 15 to 60 acres in size.

Typically, the surface layer is dark brown silt loam about 7 inches thick. The subsoil is dark yellowish brown, friable and firm silty clay loam about 33 inches thick. The substratum to a depth of 60 inches or more is brown, friable silt loam. Some areas are gently sloping.

Included with this soil in mapping are small areas of Sharpsburg and Sibley soils. These soils are on ridgetops upslope from the Knox soil. They have a dark surface layer that is more than 10 inches thick. They make up 5 to 10 percent of the unit.

Permeability is moderate in the Knox soil. Surface runoff is medium. Reaction ranges from medium acid to neutral in the subsoil and varies widely in the surface layer as a result of local liming practices. Natural fertility is high, and organic matter content is moderately low. Available water capacity is very high. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled, but it tends to puddle or crust after hard rains.

Most areas are used for cultivated crops. A small acreage is used for hay, pasture, or woodland. This soil is suited to corn, soybeans, grain sorghum, and small grain and to grasses and legumes for pasture and hay. If cultivated crops are grown, further erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, winter cover crops, and grassed waterways help to prevent excessive soil loss. Most areas can be terraced and farmed on the contour (fig. 8). Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is wet, however, damages the stand and causes surface com-

Figure 8.—Grassed-back terraces on Knox silt loam, 5 to 9 percent slopes, eroded.

paction and excessive runoff. Applications of fertilizer, proper stocking rates, pasture rotation, and timely deferment of grazing improve the pasture.

A few small areas support native hardwoods. This soil is suited to trees. No limitations or hazards affect planting or harvesting.

This soil is suited to building site development and onsite waste disposal. The shrink-swell potential is a limitation on sites for buildings without basements. Also, the slope is a limitation on sites for small commercial buildings. Adequately reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The slope can be overcome by land shaping or by designing the buildings so that they conform to the natural slope of the land. Septic tank systems function well if they are properly installed. Slope and seepage are limitations on sites for sewage lagoons. The less sloping areas, where less leveling is needed, should be selected as sites for the lagoons. Providing slowly permeable material helps to seal the lagoon and thus helps to prevent seepage.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts in low areas improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIIe.

54E2—Knox silt loam, 14 to 20 percent slopes, eroded. This deep, well drained, moderately steep soil is on strongly dissected hills and bluffs bordering the valleys of the Missouri River and its tributaries. Individual areas are irregular in shape and range from 20 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsoil is silty clay loam about 35 inches thick. The upper part is dark yellowish brown and firm, and the lower part is brown and friable. The substratum to a depth of about 60 inches is yellowish brown, friable silt loam. Some areas are strongly sloping, and a few are steep. In some eroded areas the surface layer is brown silty clay loam.

Included with this soil in mapping are small areas of the moderately well drained Nodaway and moderately deep Snead soils. Nodaway soils are on narrow bottoms. Snead soils are on the lower side slopes. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderate in the Knox soil. Surface runoff is rapid. Reaction ranges from medium acid to neutral in the subsoil and varies widely in the surface layer as a result of local liming practices. Natural fertility is high, and organic matter content is moderately low. Available water capacity is very high. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled, but it tends to puddle or crust after hard rains.

Most areas are used for pasture or woodland. This soil is suited to alfalfa and smooth bromegrass. A cover of pasture plants or hay is effective in controlling erosion. If alfalfa is grown, a high level of fertility is needed. The plants should be cut by the early bloom stage and should be at least 6 inches high just before winter. A conservation tillage system that leaves large amounts of crop residue on the surface helps to control erosion when the pasture or hayland is reestablished or renovated. Measures that prevent the formation of livestock paths up and down the slope help to keep gullies from forming. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates and pasture rotation improve the pasture.

Some areas support native hardwoods. This soil is suited to trees. The erosion hazard, the equipment limitation, and the seedling mortality rate are the main management concerns. Establishing logging roads and skid trails on the contour helps to control erosion and ensure the safe operation of equipment. In the steepest areas, the logs should be yarded uphill to the roads or trails. Disturbed areas should be seeded after the trees are harvested. Selecting a planting stock that is larger than is typical improves the seedling survival rate.

This soil is suited to building site development and onsite waste disposal. The slope is a limitation on sites for buildings. Also, the shrink-swell potential is a limitation on sites for buildings without basements. Adequately reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The slope can be overcome by land shaping or by designing the buildings so that they conform to the natural slope of the land. The laterals in septic tank absorption fields should be installed across the slope. Slope and seepage are limitations on sites for sewage lagoons. The slope can be overcome by leveling or by selecting the less sloping areas as sites for the lagoons. Providing slowly permeable material helps to seal the lagoon and thus helps to prevent seepage.

Low strength, the potential for frost action, the shrink-swell potential, and the slope are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts in low areas improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. The slope can be overcome by building on the contour.

The land capability classification is IVe.

54F—Knox silt loam, 20 to 30 percent slopes. This deep, well drained, steep soil is on strongly dissected hills and bluffs bordering the valleys of the Missouri River and its tributaries. Individual areas are irregular in shape and range from 20 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 3 inches thick. The subsoil is dark yellowish brown, friable silty clay loam about 31 inches thick. The substratum to a depth of about 60 inches is yellowish brown, friable silt loam. Some areas are moderately steep. In places erosion has removed all of the original surface layer.

Included with this soil in mapping are small areas of the moderately well drained Nodaway and moderately deep Snead soils. Nodaway soils are on narrow bottoms. Snead soils are on the lower side slopes. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderate in the Knox soil. Surface runoff is rapid. Reaction ranges from medium acid to neutral in the subsoil and varies widely in the surface layer as a result of local liming practices. Natural fertility is high, and organic matter content is moderately low. Available water capacity is very high. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled, but it tends to crust or puddle after hard rains.

This soil is suited to grasses and legumes for pasture. Because of the steep slope and severe erosion hazard, however, careful management is needed when pastures are reestablished. A conservation tillage system that leaves large amounts of crop residue on the surface helps to control erosion when the pastures or hayland is seeded or renovated. Preparing a seedbed in strips that follow the contour of the land also helps to control erosion. Measures that prevent the formation of livestock paths up and down the slope help to keep gullies from forming. Proper stocking rates and pasture rotation improve the pasture.

Most areas are used for woodland. This soil is suited to trees. The erosion hazard, the equipment limitation, and the seedling mortality rate are the main management concerns. Establishing logging roads and skid trails on the contour helps to control erosion and ensure the safe operation of equipment. In the steepest areas, the logs should be yarded uphill to the roads or trails. Disturbed areas should be seeded after the trees are harvested. Selecting a planting stock that is larger than is typical improves the seedling survival rate.

This soil generally is unsuited to building site development and onsite waste disposal because of the steep slope.

The land capability classification is VIe.

55D3—Knox silty clay loam, 5 to 14 percent slopes, severely eroded. This deep, moderately sloping and strongly sloping, well drained soil is on the convex sides of strongly dissected hills bordering the valley of the Missouri River. Individual areas are irregular in shape and range from 5 to 60 acres in size.

Typically, the surface layer is dark brown, friable silty clay loam about 5 inches thick. The subsoil is firm silty clay loam about 53 inches thick. The upper part is brown, and the lower part is dark yellowish brown. The substratum to a depth of about 65 inches is yellowish brown, friable silt loam. In some of the less eroded areas, the surface layer is very dark grayish brown silt loam.

Included with this soil in mapping are small areas of Sharpsburg and Sibley soils and narrow bands of Rock outcrop. Sharpsburg and Sibley soils have a thick, dark surface layer. Sharpsburg soils are moderately well drained and are in the less sloping areas below the Sibley soils and above the Knox soil. Sibley soils are on the wider ridgetops. The Rock outcrop is on the low parts of the side slopes. Included areas make up about 2 to 5 percent of the unit.

Permeability is moderate in the Knox soil. Surface runoff is rapid. Reaction ranges from medium acid to neutral in the subsoil. Natural fertility is medium, and organic matter content is moderately low. Available water capacity is high. The shrink-swell potential is moderate. The surface layer is friable but becomes cloddy if tilled when wet.

Most areas are used for cultivated crops. A small acreage is used for pasture or woodland. This soil generally is unsuited to cultivated crops because of the erosion hazard. It is suited to alfalfa and smooth bromegrass. A cover of pasture plants or hay is effective in controlling erosion. If alfalfa is grown, a high level of fertility is needed. The plants should be cut by the early bloom stage and should be at least 6 inches high just before winter. A conservation tillage system that leaves large amounts of crop residue on the surface helps to control erosion when the pasture or hayland is seeded or renovated. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates and pasture rotation improve the pasture.

This soil is suited to trees. No limitations or hazards affect planting or harvesting.

This soil is suited to building site development and onsite waste disposal. The slope is a limitation on sites for buildings. Also, the shrink-swell potential is a limitation on sites for buildings without basements. Adequately reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The slope can be overcome by land shaping or by designing the buildings so that they conform to the natural slope of the land. The laterals in septic tank absorption fields should be installed across the slope. Slope and seepage are limitations on sites for sewage lagoons. The slope can be overcome by leveling or by selecting the less sloping areas as sites for the lagoons. Providing slowly permeable material helps to seal the lagoon and thus helps to prevent seepage.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts in low areas improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. The slope can be overcome by building on the contour.

The land capability classification is IVe.

56B—Grundy silt loam, 2 to 5 percent slopes. This deep, gently sloping, somewhat poorly drained soil is on ridgetops, in saddles, and on side slopes in the uplands. Individual areas are irregular in shape and range from 10 to more than 200 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 6 inches thick. The subsurface layer is very dark grayish brown, firm silty clay loam about 9 inches thick. The subsoil is about 39 inches thick. It is mottled and firm. The upper part is dark grayish brown silty clay, the next part is grayish brown silty clay, and the lower part is grayish brown silty clay loam. The substratum to a depth of about 60 inches is grayish brown, mottled, firm silty clay loam. In a few areas the lower part of the subsoil contains more sand and has some pebbles.

Included with this soil in mapping are small areas of the moderately well drained Sharpsburg soils on ridgetops. These soils generally are higher on the landscape than the Grundy soil. They make up about 2 to 7 percent of the unit.

Permeability is slow in the Grundy soil. Surface runoff is slow. Reaction ranges from strongly acid to neutral in the subsoil. Natural fertility is high, and organic matter content is moderate. Available water capacity is high. A seasonal high water table commonly is at a depth of 1 to 3 feet during winter and spring. The shrink-swell potential is high. The surface layer is friable and can be easily tilled. Because of the slow permeability and the wetness, however, tillage is delayed in most years, especially early in spring.

Most areas are used as cropland. This soil is suited to corn, soybeans, grain sorghum, and small grain. If cultivated crops are grown, erosion is a hazard. Properly designed and constructed terraces and grassed waterways, a conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, and winter cover crops help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. This soil is suited to shallow-rooted legumes and to cool-season bunch grasses and native warm-season grasses. Overgrazing or grazing when the soil is wet, however, causes surface compaction and excessive runoff and damages the stand. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods improve the pasture.

This soil is suitable for building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations or basement walls help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry.

This soil generally is unsuitable as a septic tank absorption field because of the wetness and the slow permeability. Sewage lagoons function adequately if the site is leveled.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIe.

57C2—Grundy silty clay loam, 5 to 9 percent slopes, eroded. This deep, moderately sloping, somewhat poorly drained soil is on slightly concave side slopes in the uplands. Individual areas are irregular in shape and range from 10 to 150 acres in size.

Typically, the surface layer is black, friable silty clay loam about 8 inches thick. The subsoil is about 43 inches thick. It is mottled and firm. The upper part is very dark grayish brown and dark grayish brown silty clay, the next part is grayish brown silty clay and silty clay loam, and the lower part is dark gray and grayish brown silty clay loam. The substratum to a depth of about 60 inches is grayish brown, mottled, friable silt loam. In some areas the content of sand in the lower part of the subsoil is more than 5 percent.

Permeability is slow. Surface runoff is medium. Reaction ranges from strongly acid to neutral in the subsoil and varies in the surface layer as a result of local liming practices. Natural fertility is medium, and organic matter content is moderate. Available water capacity is high. A seasonal high water table commonly is at a depth of 1 to 3 feet during winter and spring. The shrink-swell potential is high. The surface layer is friable but can be easily tilled only within a somewhat narrow range in moisture content. It becomes cloddy if tilled when wet. Also, it tends to crust or puddle after hard rains, especially in plowed areas where it contains subsoil material.

Most areas are used as cropland. This soil is suited to corn, grain sorghum, soybeans, and small grain. If cultivated crops are grown, further erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, winter cover crops, and grassed waterways help to prevent excessive soil loss. Most areas can be terraced and farmed on the contour. Special management is needed if the clayey subsoil is exposed when terraces are built. The subsoil cannot be tilled easily and is lower in fertility and available water capacity than the surface layer. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. This soil is suited to shallow-rooted legumes and to cool-season bunch grasses and native warm-season grasses. Overgrazing or grazing when the soil is wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and restricted use during wet periods improve the pasture.

This soil is suitable for building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations or basement walls help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry.

This soil generally is unsuitable as a septic tank absorption field because of the wetness and the slow permeability. Sewage lagoons function adequately if they are established in the less sloping areas or if the site can be leveled.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIIe.

61C—Knox-Urban land complex, 5 to 9 percent slopes. This map unit occurs as areas of a deep, moderately sloping, well drained Knox soil intermingled with areas of Urban land. It is on narrow, convex ridges in the uplands. Individual areas are long and narrow and range from 25 to 150 acres in size. They are about 65 to 75 percent Knox soil and 25 to 35 percent Urban land. The Knox soil and Urban land occur as areas so closely intermingled that mapping them separately is not practical.

Typically, the Knox soil has a surface layer of brown, friable silt loam about 7 inches thick. The subsoil is dark yellowish brown, friable and firm silty clay loam about 33 inches thick. The substratum to a depth of about 60 inches is brown, friable silt loam. In some areas that have been altered by land shaping, the surface layer has been removed. In other areas dark yellowish brown fill material has been graded in over the surface layer.

The Urban land is covered by streets, parking lots, buildings, and other structures that so obscure or alter the soils that identification of the soil series is not feasible.

Permeability is moderate in the Knox soil. Surface runoff is medium. Reaction ranges from medium acid to neutral in the subsoil and varies widely in the surface layer as a result of local liming practices. Natural fertility is high, and organic matter content is moderately low. Available water capacity is very high. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled, but it tends to crust or puddle after hard rains.

The Knox soil is suited to lawn grasses, shade and ornamental trees, shrubs, vines, and vegetable gardens. It also is suited to those recreational uses that can be adapted to the shape and the limited size of the open areas. Because of the slopes, land shaping may be needed if the soil is used for playgrounds or picnic areas.

The Knox soil is suited to building site development. The shrink-swell potential is a limitation on sites for dwellings without basements. Adequately reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. All sanitary facilities should be connected to commercial sewers.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if the Knox soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

No land capability classification is assigned.

61D—Knox-Urban land complex, 9 to 14 percent slopes. This map unit occurs as areas of a deep, strongly sloping, well drained Knox soil intermingled with areas of Urban land. It is on convex side slopes in the uplands. Individual areas are irregular in shape and range from 15 to 450 acres in size. They are about 65 to 75 percent Knox soil and 20 to 30 percent Urban land. The Knox soil and Urban land occur as areas so closely intermingled that mapping them separately is not practical.

Typically, the Knox soil has a surface layer of dark brown, friable silty clay loam about 5 inches thick. The subsoil is brown and dark yellowish brown, friable silty clay loam about 53 inches thick. The substratum to a depth of about 60 inches is yellowish brown, friable silt loam. In some areas that have been altered by land shaping, dark yellowish brown fill material has been graded in over the surface layer. In places the subsoil has a higher content of clay.

The Urban land is covered by streets, parking lots, buildings, and other structures that so obscure or alter the soils that identification of the soil series is not feasible.

Included with this unit in mapping are small areas of the moderately deep Snead soils. These soils are on the lower parts of the slopes. They make up less than 5 percent of the unit.

Permeability is moderate in the Knox soil. Surface runoff is rapid. Reaction ranges from medium acid to neutral in the subsoil. Natural fertility is medium, and organic matter content is low. Available water capacity is high. The shrink-swell potential is moderate. The surface layer is friable, but it crusts or puddles after hard rains.

The Knox soil is suited to lawn grasses, shade and ornamental trees, shrubs, vines, and gardens. It also is suited to those recreational uses that can be adapted to the shape and the limited size of the open areas. Because of the slope, land shaping is needed if the soil is used for picnic areas or playgrounds.

The Knox soil is suited to building site development. The slope is a limitation. Also, the shrink-swell potential is a limitation on sites for dwellings without basements. Adequately reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The slope can be overcome by land shaping or by designing the buildings so that they conform to the natural slope of the land. All sanitary facilities should be connected to commercial sewers.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if the Knox soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

No land capability classification is assigned.

61E—Knox-Urban land complex, 14 to 20 percent slopes. This map unit occurs as areas of a deep, moderately steep, well drained Knox soil intermingled with areas of Urban land. It is on convex side slopes in the uplands. Individual areas are irregular in shape and range from 15 to 300 acres in size. They are about 70 to 80 percent Knox soil and 15 to 25 percent Urban land. The Knox soil and Urban land occur as areas so closely intermingled that mapping them separately is not practical.

Typically, the Knox soil has a surface layer of very dark grayish brown, friable silt loam about 7 inches thick. The subsoil is friable silty clay loam about 35 inches thick. The upper part is dark yellowish brown, and the lower part is brown. The substratum to a depth of about 60 inches is yellowish brown, friable silt loam. In some areas that have been altered by land shaping, the surface layer has been removed. In other areas dark yellowish brown fill material has been graded in over the surface layer.

The Urban land is covered by streets, parking lots, buildings, and other structures that so obscure or alter the soils that identification of the soil series is not feasible.

Included with this unit in mapping are small areas of the moderately deep Snead soils. These soils are on the lower parts of the slopes. They make up less than 5 percent of the unit.

Permeability is moderate in the Knox soil. Surface runoff is rapid. Reaction ranges from medium acid to neutral in the subsoil and varies widely in the surface layer. Natural fertility is high, and organic matter content is moderately low. Available water capacity is very high. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled, but it tends to crust or puddle after hard rains.

The Knox soil is suited to lawn grasses, shade and ornamental trees, shrubs, vines, and gardens. The slope is a severe limitation on sites for picnic areas and playgrounds and a moderate limitation on sites for paths and trails. Land shaping is needed. Also, the recreational uses should be those that can be adapted to the shape and the limited size of the open areas.

The Knox soil is suited to building site development. Extensive site preparation generally is needed, however, because of the slope. Also, the shrink-swell potential is a limitation on sites for dwellings without basements. Adequately reinforcing the concrete in foundations, footings, and basement walls with steel and backfilling with sand and gravel around the foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The slope can be overcome by land shaping or by designing the dwellings so that they conform to the natural slope of the land. All sanitary facilities should be connected to commercial sewers.

Low strength, the potential for frost action, the shrink-swell potential, and the slope are limitations if the Knox soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. The slope can be overcome by building on the contour.

No land capability classification is assigned.

68C—Urban land, upland, 5 to 9 percent slopes. This map unit occurs as moderately sloping areas on uplands where more than 85 percent of the surface is covered by buildings, asphalt, concrete, and other impervious material. Examples of these areas are parking lots, shopping and business centers, railroad yards, and industrial developments. Most of this Urban land is in the southwestern part of the survey area. The largest areas are in the business districts of Gladstone and Liberty, and the smaller ones are industrial parks and shopping malls. The landscape generally has been extensively reshaped by cutting and filling, which have lessened the slope or created different levels within an area. Individual areas range from about 20 to 130 acres in size.

The composition of soil material in the open areas varies widely. The vegetation is primarily ornamental trees, shrubs, and lawn grasses.

The depth of cuts and fills on this land ranges from less than 3 feet in some of the less sloping areas to more than 20 feet in the more sloping areas. Identification of the soils in this unit is impractical because of the urban structures and the extreme variability of the soil. Onsite investigation is needed before changes in the kind or intensity of use are made.

No land capability classification is assigned.

69A—Urban land, bottom land, 0 to 3 percent slopes. This map unit occurs as nearly level areas on bottom land where more than 85 percent of the surface is covered by buildings, concrete, asphalt, and other impervious material. Examples of these areas are industrial developments, parking lots, shopping and business centers, railroad yards, and airports. This Urban land is in Clay County, mainly in the southwestern part. It is on flood plains along the Missouri River or along tributaries close to the river. The areas along the tributary streams have been built up above normal flood levels. They may be flooded for short periods, however, by local floodwater. Also, extremely large floods generally occur in some areas for longer periods. The areas on the flood plains along the Missouri River are protected by levees but are still occasionally flooded because of levee breaks or by overflow from local tributaries. Individual areas of this unit range from 14 to about 2,300 acres in size.

The composition of soil material in the open areas varies widely. The vegetation is primarily ornamental trees, shrubs, and lawn grasses.

The amount of fill material on this land ranges from none in the higher areas to 10 feet or more in the lower areas. Identification of the soils in this unit is impractical because of the urban structures and the extreme variability of the soils. Onsite investigation is needed before changes in the kind or intensity of use are made.

No land capability classification is assigned.

70B—Sharpsburg-Urban land complex, 2 to 5 percent slopes. This map unit occurs as areas of a deep, gently sloping, moderately well drained Sharpsburg soil intermingled with areas of Urban land (fig. 9). It is on convex ridgetops in the uplands. Individual areas generally are long and narrow and range from 15 to more than 250 acres in size. They are about 60 percent Sharpsburg soil and 35 percent Urban land. The Sharpsburg soil and Urban land occur as areas so closely intermingled that mapping them separately is not practical.

Typically, the Sharpsburg soil has a surface layer of black, friable silt loam about 11 inches thick. The subsurface layer is very dark grayish brown, friable silt loam about 6 inches thick. The subsoil is silty clay loam about 38 inches thick. It is dark brown and friable in the upper part and dark yellowish brown and yellowish brown, mottled, and firm in the lower part. The substratum to a depth of about 60 inches is mottled grayish brown and dark yellowish brown, friable silt loam. In some areas the subsoil does not have gray mottles.

The Urban land is covered by streets, parking lots, buildings, and other structures that so obscure or alter the soils that identification of the soil series is not feasible.

Included with this unit in mapping are small areas of the somewhat poorly drained Macksburg soils. These soils are at the head of drainageways and in saddles. They make up about 5 percent of the unit.

Permeability is moderately slow in the Sharpsburg soil. Surface runoff is medium. Reaction is medium acid to neutral in the subsoil. Natural fertility is high, and organic matter content is moderate. Available water capacity is high. The shrink-swell potential is moderate.

The Sharpsburg soil is well suited to lawn grasses, shade and ornamental trees, shrubs, vines, and vegetable gardens. It is suitable for those recreational uses that can be adapted to the shape and the limited size of the open areas. It has slight limitations as a site for paths and trails. The moderately slow permeability is a limitation on sites for picnic areas and playgrounds. Also, the slope is a limitation on sites for playgrounds. It can be overcome, however, by land shaping. The moderately slow permeability can be overcome by resurfacing areas

Figure 9.—Urban development in an area of Sharpsburg-Urban land complex, 2 to 5 percent slopes.

that are subject to heavy foot traffic with fine gravel or other suitable material and by installing drainage tile.

The Sharpsburg soil is suited to building site development. The shrink-swell potential is a limitation on sites for dwellings. Adequately reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. All sanitary facilities should be connected to commercial sewers.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if the Sharpsburg soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

No land capability classification is assigned.

70C—Sharpsburg-Urban land complex, 5 to 9 percent slopes. This map unit occurs as areas of a deep, moderately sloping, moderately well drained Sharpsburg soil intermingled with areas of Urban land. It is on convex side slopes in the uplands. Individual areas are irregular in shape and range from 15 to 500 acres in size. They are about 60 percent Sharpsburg soil and 35 percent Urban land. The Sharpsburg soil and Urban land occur as areas so closely intermingled that mapping them separately is not practical.

Typically, the Sharpsburg soil has a surface layer of very dark grayish brown, friable silt loam about 8 inches thick. The subsoil is firm silty clay loam about 37 inches thick. The upper part is brown, and the lower part is dark yellowish brown and mottled. The substratum to a depth of about 60 inches is mottled grayish brown and brown, friable silt loam. In some areas the lower part of the subsoil does not have gray mottles.

The Urban land is covered by streets, parking lots, buildings, and other structures that so obscure or alter the soils that identification of the soil series is not feasible.

Included with this unit in mapping are small areas of the somewhat poorly drained Lagonda and Macksburg soils. These soils are in slightly concave areas below the Sharpsburg soil and at the head of drainageways. They make up about 5 percent of the unit.

Permeability is moderately slow in the Sharpsburg soil. Surface runoff is rapid. Reaction is strongly acid to slightly acid in the subsoil and varies in the surface layer because of local liming practices. Natural fertility is medium, and organic matter content is moderate. Available water capacity is high. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled, but it tends to crust or puddle after hard rains.

The Sharpsburg soil is suited to lawn grasses, shade and ornamental trees, shrubs, vines, and vegetable gardens. It also is suited to those recreational uses that can be adapted to the shape and the limited size of the open areas. It has slight limitations as a site for paths and trails. The moderately slow permeability is a limitation on sites for picnic areas and playgrounds. Also, the slope is a limitation on sites for playgrounds. It can be overcome, however, by land shaping. The moderately slow permeability can be overcome by resurfacing areas that are subject to heavy foot traffic with fine gravel or other suitable material and by installing drainage tile.

The Sharpsburg soil is suited to building site development. The shrink-swell potential is a limitation on sites for dwellings. Adequately reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations and basements walls help to prevent the structural damage caused by shrinking and swelling. All sanitary facilities should be connected to commercial sewers.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if the Sharpsburg soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

No land capability classification is assigned.

70D—Sharpsburg-Urban land complex, 9 to 14 percent slopes. This map unit occurs as areas of a deep, strongly sloping, moderately well drained Sharpsburg soil intermingled with areas of Urban land. It is on convex side slopes and the ends of ridges in the uplands. Individual areas are irregular in shape and range from 15 to more than 350 acres in size. They are about 60 percent Sharpsburg soil and 35 percent Urban land. The Sharpsburg soil and Urban land occur as areas so closely intermingled that mapping them separately is not practical.

Typically, the Sharpsburg soil has a surface layer of very dark grayish brown, friable silt loam about 9 inches thick. The subsoil is firm silty clay loam about 35 inches thick. The upper part is brown, and the lower part is mottled brown, grayish brown, and yellowish brown. The substratum to a depth of about 60 inches is mottled grayish brown and dark yellowish brown, friable silt loam. In some areas the subsoil does not have gray mottles.

Included with this unit in mapping are small areas of Armster soils and small areas of the somewhat poorly drained Macksburg soils. Armster soils are on side slopes and are lower on the landscape than the Sharpsburg soil. Also, they have a higher content of sand and gravel. Macksburg soils are at the head of drainageways. Included soils make up about 5 percent of the unit.

Permeability is moderately slow in the Sharpsburg soil. Surface runoff is rapid. Reaction is medium acid to neutral in the subsoil. Natural fertility is medium, and organic matter content is moderate. Available water capacity is high. The shrink-swell potential is moderate. The surface layer is friable but tends to crust or puddle after hard rains.

The Sharpsburg soil is suited to lawn grasses, shade and ornamental trees, shrubs, vines, and gardens. It also is suited to those recreational uses that can be adapted to the shape and the limited size of the open areas. It has slight limitations as a site for paths and trails. The moderately slow permeability and the slope are limitations on sites for picnic areas and playgrounds. The moderately slow permeability can be overcome by resurfacing areas that are subject to heavy foot traffic with fine gravel or other suitable material and by installing drainage tile. The slope can be overcome by land shaping.

The Sharpsburg soil is suited to building site development. The shrink-swell potential and the slope are limitations on sites for dwellings. Adequately reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The slope can be overcome by land shaping or by designing the dwellings so that they conform to the natural slope of the land. All sanitary facilities should be connected to existing commercial sewers.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if the Sharpsburg soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

No land capability classification is assigned.

71—Aholt clay. This deep, nearly level, very poorly drained soil is in a slightly depressional area on the flood plains along the Missouri River. It is protected by levees but still is occasionally flooded by overflow from local tributaries or because of levee breaks. It occurs as one irregularly shaped area about 2,700 acres in size.

Typically, the surface layer is black, very firm clay about 6 inches thick. The subsoil extends to a depth of 60 inches or more. The upper part is very dark gray and dark gray, very firm clay; the next part is gray, mottled, very firm clay; and the lower part is gray and yellowish brown, mottled, firm silty clay loam. In a few areas very dark grayish brown silty clay loam overwash has been recently deposited.

Included with this soil in mapping are a few areas of Aholt soils that are ponded for significant periods, small areas of the well drained Norborne soils on old natural levees, and areas of Wabash soils between the Aholt soil and the stream channels. Norborne soils are more sandy than the Aholt soil. The content of clay is less than 60 percent throughout the Wabash soils. Included soils make up less than 5 percent of the unit.

Permeability is very slow in the Aholt soil. Surface runoff also is very slow. Reaction is neutral in the surface layer and ranges from neutral to moderately alkaline in the subsoil. The soil is calcareous throughout. Natural fertility is medium, and organic matter content is high. Available water capacity is moderate. A seasonal high water table commonly is within a depth of 1 foot during winter and spring. The shrink-swell potential is very high. The surface layer is high in content of clay and can be tilled only within a very narrow range in moisture content. It puddles and crusts after hard rains.

Nearly all of the acreage is used for cultivated crops. This soil is suited to soybeans, corn, and small grain. The wetness is the main limitation. It can be reduced, however, by land grading, shallow surface drains, and open ditches. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration. Plowing in the fall improves tilth for the crops grown the following spring.

This soil is suited to trees. The equipment limitation, the windthrow hazard, plant competition, and seedling mortality are management concerns. The use of equipment should be limited to periods when the surface is dry or frozen. Ridging the soil and planting larger stock than is typical on the ridges improve the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where the windthrow hazard is slight. Thorough site preparation helps to control plant competition.

This soil generally is unsuitable for building site development and onsite waste disposal because of the flooding and the wetness.

The land capability classification is IIIw.

72—Dockery silt loam. This deep, nearly level, somewhat poorly drained soil is on the flood plains along the Missouri River. It is protected by levees but still is occasionally flooded by overflow from local tributaries or because of levee breaks. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 8 inches. The substratum to a depth of about 60 inches is friable silt loam. It is very dark grayish brown and grayish brown in the upper part, stratified very dark grayish brown and grayish brown and mottled in the next part, and grayish brown and very dark gray and mottled in the lower part. In some areas the substratum has thin layers of coarser or finer textured material.

Included with this soil in mapping are small areas of Modale soils. These soils are loamy or silty in the upper part and clayey in the lower part. They are slightly lower on the landscape than the Dockery soil. They make up less than 5 percent of the unit.

Permeability is moderate in the Dockery soil. Surface runoff is slow in cultivated areas. Reaction is slightly acid or neutral in the substratum and varies widely in the surface layer as a result of local liming practices. Natural fertility is high, and organic matter content is moderate. Available water capacity is very high. A seasonal high water table commonly is at a depth of 2 to 3 feet during winter and spring. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. It tends to crust or puddle, however, after hard rains.

Most areas are used for cultivated crops (fig. 10). This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, the wetness is a limitation in some areas. It can be reduced, however, by land grading, shallow surface drains, and open ditches. Field drains also help to remove the excess water. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is suited to shallow-rooted legumes and cool-season bunch grasses for pasture and hay. The species that can grow in a wet soil should be selected for planting. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth and decreases the rate of infiltration. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods improve the pasture.

This soil is suited to trees. No limitations or hazards affect harvesting or planting.

This soil generally is unsuited to building site development and onsite waste disposal because of the wetness and the occasional flooding. The history of flooding in a given area should be considered when sites for buildings and sanitary facilities are selected.

The land capability classification is IIw.

Figure 10.—Harvesting soybeans in an area of Dockery silt loam.

73—Leta silty clay. This deep, nearly level, somewhat poorly drained soil is on bottom land along the Missouri River. It is protected by levees but still is occasionally flooded by overflow from local tributaries or because of levee breaks. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is very dark gray, very firm silty clay about 5 inches thick. The subsurface layer also is very dark gray, very firm silty clay. It is about 9 inches thick. The subsoil is dark grayish brown, very firm silty clay about 20 inches thick. The substratum to a depth of about 60 inches is stratified light olive brown, dark grayish brown, and grayish brown, friable silt loam and very fine sandy loam. In a few areas the silty clay in the upper part of the soil is less than 20 inches thick.

Included with this soil in mapping are small areas of Modale soils. These soils are loamy or silty in the upper part. They are slightly higher on the landscape than the Leta soil. They make up 5 to 10 percent of the unit.

Permeability is slow in the upper part of the Leta soil and moderate in the loamy lower part. Surface runoff generally is slow. The soil is mildly alkaline or moderately alkaline throughout. Natural fertility is high, and organic matter content is moderate. Available water capacity also is moderate. A seasonal high water table is at a depth of 1 to 3 feet during winter and spring. The shrink-swell potential is high in the surface soil and subsoil and low in the substratum. The surface layer is very firm when dry and sticky when wet and becomes cloddy if tilled when wet or dry. As a result, careful timing of tillage is needed.

Most areas are used for cultivated crops. This soil is suited to soybeans, grain sorghum, corn, and winter wheat. In some areas, surface runoff is very slow and the surface is covered by water after hard rains or by the runoff from adjacent areas. Land grading, shallow surface drains, and open ditches help to remove the excess surface water. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is suited to trees. The equipment limitation, the seedling mortality rate, and the windthrow hazard are the main management concerns. The use of equipment should be limited to periods when the surface is dry or frozen. Ridging the soil and planting larger stock than is typical on the ridges improve the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where the windthrow hazard is slight.

This soil generally is unsuited to building site development and onsite waste disposal because of the wetness and the occasional flooding. The history of flooding in a given area should be considered when sites for buildings and sanitary facilities are selected.

The land capability classification is IIw.

74—Levasy silty clay. This deep, nearly level to slightly depressional, poorly drained soil is on the flood plains along the Missouri River. It is protected by levees but still is occasionally flooded by overflow from local tributaries or because of levee breaks. It commonly is ponded after heavy rains. Individual areas range from 10 to more than 100 acres in size.

Typically, the surface layer is very dark gray, very firm silty clay about 6 inches thick. The subsurface layer also is very dark gray, very firm silty clay. It is about 8 inches thick. The subsoil is dark grayish brown, mottled, very firm silty clay about 18 inches thick. The substratum to a depth of about 60 inches is dark grayish brown, mottled, friable or very friable silt loam and very fine sandy loam. In some areas the clayey surface soil extends to a depth of more than 38 inches.

Included with this soil in mapping are small areas of Leta, Parkville, and Waldron soils on the slightly higher parts of the landscape. Leta soils are somewhat poorly drained. Parkville soils have clayey layers to a depth of less than 20 inches. Waldron soils are clayey throughout the substratum. Included soils make up about 5 to 10 percent of the unit.

Permeability is slow in the clayey upper part of the Levasy soil and moderate in the loamy lower part. Surface runoff is very slow or ponded. The soil is mildly alkaline or moderately alkaline throughout. Natural fertility is medium, and organic matter content is moderate. Available water capacity also is moderate. A seasonal high water table is 1.0 foot above the surface to 1.5 feet below during winter and spring. The shrink-swell potential is high in the clayey upper part of the soil and low in the loamy lower part. The surface layer is high in content of clay and can be easily tilled only within a narrow range in moisture content. It crusts or puddles after hard rains.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain. The wetness is the main limitation. It can be reduced, however, by open ditches, shallow surface drains, and land grading. Returning crop residue to the soil or regularly adding other organic material improves fertility and tilth, helps to prevent surface crusting, and increases the rate of water infiltration. Fall plowing results in better tilth when the soil is tilled the following spring.

This soil is suited to trees. The equipment limitation, the windthrow hazard, plant competition, and seedling mortality are management concerns. The use of equipment should be limited to periods when the surface is dry or frozen. Ridging the soil and planting larger stock than is typical on the ridges improve the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where the windthrow hazard is slight. Thorough site preparation, which may include spraying or cutting, helps to control plant competition.

This soil generally is unsuited to building site development and onsite waste disposal because of the ponding and the occasional flooding.

The land capability classification is IIIw.

75—Norborne very fine sandy loam. This deep, nearly level, well drained soil is in the slightly higher areas on the flood plains along the Missouri River. It is subject to rare flooding. Individual areas are long and moderately wide and range from 50 to 200 acres in size.

Typically, the surface layer is very dark brown, very friable very fine sandy loam about 9 inches thick. The subsurface layer also is very dark brown, very friable very fine sandy loam. It is about 8 inches thick. The subsoil is very dark brown, dark brown, and brown, very friable and friable very fine sandy loam about 28 inches thick. The substratum to a depth of about 60 inches is brown, mottled, very friable very fine sandy loam.

Included with this soil in mapping are small areas of Cotter, Landes, and Leta soils. Cotter soils have a silty subsoil. They are in the slightly lower areas. Landes soils contain more sand than the Norborne soil. They are on long, narrow ridges at the slightly higher elevations. Leta soils have a clayey surface layer. They are in small depressions. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderate in the Norborne soil. Surface runoff is slow. Reaction is neutral or slightly acid throughout the profile. Natural fertility is high, and organic matter content is moderate. Available water capacity is high. The surface layer is friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, small grain, and grain sorghum. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is suited to alfalfa, bromegrass, and most other grasses and legumes for pasture and hay. Overgrazing or grazing when the soil is wet, however, causes surface compaction and poor tilth and decreases the rate of water infiltration. Proper stocking rates, pasture rotation, and timely deferment of grazing improve the pasture.

This soil is suited to trees. No hazards or limitations affect planting or harvesting.

This soil is suited to building site development and onsite waste disposal, but the flooding is a hazard. The history of flooding in a given area should be considered when sites for buildings and sanitary facilities are selected. If protected from flooding and properly designed and installed, septic tanks function adequately. Constructing dwellings and local roads and streets on raised, well compacted fill material helps to overcome the flooding. Low strength and the potential for frost action are limitations on sites for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is I.

78—Myrick silty clay loam. This deep, nearly level, poorly drained soil is in depressional areas on the flood plains along the Missouri River. In most areas it is protected by levees but still is occasionally flooded by overflow from local tributaries or because of levee breaks. Ponding is common in some areas that receive runoff from surrounding areas. Individual areas generally are long and narrow and range from 10 to 230 acres in size.

Typically, the surface layer is very dark grayish brown, firm silty clay loam about 4 inches thick. The subsurface layer is black, very firm silty clay about 9 inches thick. The substratum to a depth of 60 inches is stratified, grayish brown, mottled very fine sandy loam and silt loam. In some areas the clayey layers are more than 20 inches thick.

Included with this soil in mapping are small areas of the somewhat poorly drained Leta and Waldron soils. Leta soils have clayey layers that are more than 20 inches thick. They are slightly higher on the landscape than the Myrick soil. Waldron soils are clayey throughout and have thin layers of coarser textured material. They occur as narrow bands on the slightly higher parts of the landscape. Included soils make up about 5 percent of the unit.

Permeability is slow in the upper part of the Myrick soil and moderate in the lower part. Runoff is very slow or ponded. Reaction is mildly alkaline or moderately alkaline in the substratum and varies widely in the surface layer as a result of local liming practices. Natural fertility is medium, and organic matter content is moderate. Available water capacity also is moderate. A seasonal high water table is 1 foot above the surface to 1 foot below during winter and spring. The shrink-swell potential is high in the surface soil and low in the substratum. The surface layer is firm and can be easily tilled only within a narrow range in moisture content. If tilled when wet or dry, it becomes cloddy and compacted. Ponded areas dry out very slowly in the spring.

In most areas this soil is cultivated along with the surrounding soils. Soybeans, corn, and grain sorghum are the main cultivated crops. Crop failure is common because of the wetness. Diversion terraces that intercept the runoff from the adjacent uplands, land grading, shallow surface drains, and open ditches help to remove surface water and improve internal drainage. A conservation tillage system that leaves crop residue on the surface helps to prevent surface compaction. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is suited to trees. The equipment limitation, the windthrow hazard, plant competition, and seedling mortality are management concerns. The use of equipment should be limited to periods when the surface is dry or frozen. Ridging the soil and planting larger stock than is typical on the ridges improve the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where the windthrow hazard is slight. Thorough site preparation helps to control plant competition.

This soil generally is unsuited to building site development and onsite waste disposal because of the ponding and the flooding.

The land capability classification is Vw.

80—Landes fine sandy loam. This deep, nearly level, well drained soil is in the higher areas on the flood plains along the Missouri River. It is protected by levees but still is occasionally flooded by overflow from local tributaries or because of levee breaks. Individual areas are irregular in shape and range from 10 to more than 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable fine sandy loam about 6 inches thick. The subsurface layer is very dark grayish brown and dark brown, friable fine sandy loam about 12 inches thick. The subsoil is brown fine sandy loam about 9 inches thick. The substratum to a depth of about 68 inches is stratified, brown, friable loamy fine sand and stratified, light brownish gray and brown loamy fine sand and sand.

Included with this soil in mapping are small areas of Haynie, Norborne, and Waldron soils. Haynie soils contain less sand than the Landes soil. Their positions on the landscape are similar to those of the Landes soil. Norborne soils are slightly higher on the landscape than the Landes soil. Also, they have a thicker dark surface layer. Waldron soils contain more clay than the Landes soil. Also, they are lower on the landscape. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderately rapid in the upper part of the Landes soil and rapid in the lower part. Surface runoff is slow. Reaction is neutral in the upper part of the soil and moderately alkaline in the lower part. Natural fertility is low, and organic matter content is moderately low. Available water capacity is moderate. A seasonal high water table is at a depth of 4 to 6 feet during most of the winter and spring. The surface layer is friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. This soil is suited to soybeans and small grain. It generally is not suited to corn, however, because of insufficient soil moisture in the summer. Returning crop residue to the soil and regularly adding other organic material increase the available water capacity, improve fertility, and help to prevent surface crusting.

This soil is suited to alfalfa, smooth bromegrass, and most other grasses and legumes for pasture and hay. Overgrazing pastures or cutting hay during dry periods damages the stand. Proper stocking rates, pasture rotation, and timely deferment of grazing improve the pasture.

This soil is suited to trees. Plant competition is the main management concern. It can be controlled by thorough site preparation, which may include cutting or spraying. No other hazards or limitations affect harvesting or planting.

This soil generally is unsuited to building site development and onsite waste disposal because of the flooding.

The land capability classification is IIIs.

81—Waldron silty clay loam. This deep, nearly level, somewhat poorly drained soil is on the flood plains along the Missouri River. It is protected by levees but still is occasionally flooded by overflow from local tributaries or because of levee breaks. Individual areas are irregular in shape and are 15 to 20 acres in size.

Typically, the surface layer is very dark gray and very dark grayish brown, firm silty clay loam about 9 inches thick. The upper part of the substratum is stratified, very dark grayish brown, very firm silty clay and clay. The next part is stratified, dark grayish brown, mottled, very firm silty clay and grayish brown very fine sandy loam. The lower part to a depth of about 60 inches is dark grayish brown, firm silty clay and grayish brown, mottled silty clay. In some areas the surface layer is silty clay.

Included with this soil in mapping are small areas of Leta and Modale soils and small areas of a poorly drained soil. Leta soils typically are clayey in the upper part and loamy in the lower part. Modale soils are silty or loamy in the upper part and clayey in the lower part. Included soils make up about 10 to 15 percent of the unit.

Permeability is slow in the Waldron soil. Surface runoff also is slow. The soil ranges from neutral to moderately alkaline throughout. Natural fertility is medium, and organic matter content is moderate. Available water capacity also is moderate. A seasonal high water table is at a depth of 1 to 3 feet during winter and spring. The shrink-swell potential is moderate in the surface layer and high in the substratum. The surface layer is firm when dry and sticky when wet and becomes cloddy if tilled when wet or dry. As a result, careful timing of tillage is needed.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and small grain. The wetness is the main limitation. It can be reduced, however, by open ditches, shallow surface drains, and land grading. Returning crop residue to the soil or regularly adding other organic material improves fertility and tilth, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is suited to hay and pasture. The wetness is the main limitation. It can be overcome, however, by open ditches, selection of species that can grow in a wet soil, and land grading. Overgrazing or grazing when the soil is wet damages the stand. Proper stocking rates, applications of fertilizer, and pasture rotation improve the pasture.

This soil is suited to trees. The equipment limitation, the windthrow hazard, and the seedling mortality rate are the main management concerns. The use of equipment should be limited to periods when the surface is dry or frozen. Selecting a planting stock that is larger than is typical improves the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where the windthrow hazard is slight.

This soil generally is unsuited to building site development and onsite waste disposal because of the wetness and the occasional flooding. The history of flooding in a given area should be considered when sites for buildings and sanitary facilities are selected.

The land capability classification is IIw.

82—Parkville silty clay. This deep, nearly level, somewhat poorly drained soil is on the flood plains along the Missouri River. It is protected by levees but still is occasionally flooded by overflow from local tributaries or because of levee breaks. Areas are irregular in shape and range from 20 to 100 acres in size.

Typically, the surface layer is black, firm silty clay about 5 inches thick. The subsurface layer is black and very dark gray, very firm silty clay about 14 inches thick. The substratum to a depth of about 72 inches is brown and grayish brown, mottled, very friable silt loam. In some areas the clayey upper part of the soil is more than 20 inches thick.

Included with this soil in mapping are small areas of the poorly drained Myrick soils. These soils have grayish brown mottles in the lower part of the subsurface layer. They are in depressional areas. They make up 5 to 10 percent of the unit.

Permeability is very slow in the upper part of the Parkville soil and moderate in the lower part. Surface runoff is slow. The soil is neutral to moderately alkaline and has free carbonates throughout. Natural fertility is medium, and organic matter content is moderate. Available water capacity is high. A seasonal high water table is at a depth of 1 to 2 feet during winter and spring. The shrink-swell potential is high in the clayey upper part of the soil and low in the loamy lower part. The surface layer is firm and becomes cloddy if tilled when wet. As a result, careful timing of tillage is needed.

Most areas are used for cultivated crops. This soil is suited to soybeans, grain sorghum, corn, and winter wheat. The wetness is the main limitation. The soil warms up slowly in the spring and dries slowly after wet periods. As a result, fieldwork is delayed. Land grading, shallow surface drains, and open ditches help to remove the excess water. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is suited to trees. The equipment limitation, the windthrow hazard, plant competition, and seedling mortality are management concerns. The use of equipment should be limited to periods when the surface is dry or frozen. Selecting a planting stock that is larger than is typical improves the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where the windthrow hazard is slight. Thorough site preparation and cutting or spraying help to control plant competition.

This soil generally is unsuited to building site development and onsite waste disposal because of the wetness and the flooding. The history of flooding in a given area should be considered when sites for buildings and sanitary facilities are selected.

The land capability classification is IIw.

83—Haynie silt loam. This deep, nearly level, moderately well drained soil is in the slightly higher areas on the flood plains along the Missouri River. It is protected by levees but still is occasionally flooded by overflow from local tributaries or because of levee breaks. Individual areas generally are long and narrow and range from 20 to more than 100 acres in size.

Typically, the surface layer is very dark grayish brown, very friable silt loam about 9 inches thick. The upper part of the substratum is dark grayish brown, mottled, very friable silt loam. The lower part to a depth of 60 inches is grayish brown, very friable or loose very fine sandy loam and loamy fine sand.

Included with this soil in mapping are small areas of the well drained Landes soils. These soils contain more sand than the Haynie soil. They are in the slightly higher areas. Also included are areas of the somewhat poorly drained Leta and Waldron soils. These soils are clayey in the upper part. They are in small drainageways and depressions. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderate in the Haynie soil. Surface runoff is slow. The soil is mildly alkaline or moderately alkaline and calcareous throughout. Natural fertility is high, and organic matter content is moderately low. Available water capacity is very high. The surface layer is friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghum, and small grain. The flooding may cause some crop losses but is not a major problem. Returning crop residue to the soil or regularly adding other organic material improves fertility and tilth and increases the rate of water infiltration.

This soil is suited to alfalfa and smooth bromegrass for hay and pasture. Overgrazing or grazing when the soil is wet, however, causes surface compaction and poor tilth and damages the stand. Applications of fertilizer, proper stocking rates, pasture rotation, and timely deferment of grazing improve the pasture.

This soil is suited to trees. Plant competition is the only management concern. It can be controlled by thorough site preparation, which may include spraying or cutting.

This soil generally is unsuited to building site development and onsite waste disposal because of the flooding.

The land capability classification is IIw.

87—Modale silt loam. This deep, nearly level, somewhat poorly drained soil is on bottom land along the Missouri River. It is protected by levees but still is occasionally flooded because of levee breaks. Individual areas are irregular in shape and range from 15 to more than 200 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 9 inches thick. The upper part of the substratum is dark grayish brown, mottled, very friable very fine sandy loam. The lower part to a depth of about 60 inches is very dark grayish brown and dark grayish brown silty clay and light brownish gray silt loam. In some areas the dark surface layer is 10 or more inches thick. In other areas the soil has very dark grayish brown buried layers more than 10 inches thick.

Included with this soil in mapping are some areas of Gilliam and Leta soils. Gilliam soils do not have a thick clayey layer in the substratum. They are in the slightly lower areas. Leta soils are clayey in the upper part. They are in the lower areas. Included soils make up about 5 to 10 percent of the map unit.

Permeability is moderate in the upper part of the Modale soil and slow in the lower part. Surface runoff is slow. Reaction is mildly alkaline or moderately alkaline in the substratum. Natural fertility is high, and organic matter content is moderately low. Available water capacity is moderate. A seasonal high water table is at a depth of 1 to 3 feet during winter and spring. The shrink-swell potential is high in the clayey lower part of the soil. The surface layer is friable and can be easily tilled throughout a moderately wide range in moisture content.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghum, and winter wheat. The wetness is the main limitation. It can be reduced, however, by land grading, shallow surface drains, and open ditches. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration.

This soil generally is unsuitable for building site development and onsite waste disposal because of the flooding. The history of flooding in a given area should be considered when sites for buildings and sanitary facilities are selected.

The land capability classification is I.

88—Gilliam silt loam. This deep, nearly level, somewhat poorly drained soil is in depressional areas on the flood plains along the Missouri River. It is protected by levees but still is occasionally flooded by overflow from local tributaries or because of levee breaks. Individual areas are irregular in shape and range from 20 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 6 inches thick. The subsurface layer is about 15 inches thick. It is very dark grayish brown, friable silt loam in the upper part and very dark brown, firm silty clay loam in the lower part. The upper part of the substratum is dark grayish brown, mottled, friable silt loam. The next part is a buried layer of very dark grayish brown, firm silty clay loam. The lower part to a depth of about 60 inches is dark grayish brown, mottled, friable silt loam and loose very fine sand. In some areas the substratum has thin strata of silty clay, fine sandy loam, or loamy fine sand below a depth of 40 inches.

Included with this soil in mapping are small areas of Haynie, Leta, and Waldron soils. Haynie soils have a higher content of very fine sand than the Gilliam soil. Also, they are higher on the landscape. Leta and Waldron soils are lower on the landscape than the Gilliam soil. Leta soils are clayey in the upper part. Waldron soils contain more clay throughout than the Gilliam soil. Included soils make up about 10 percent of the unit.

Permeability is moderate in the Gilliam soil. Surface runoff is slow. Reaction is mildly alkaline or moderately alkaline below the surface layer. Natural fertility is high, and organic matter content is moderate. Available water capacity is very high. A seasonal high water table is at a depth of 1.5 to 3.0 feet during winter and spring. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghum, and winter wheat. The wetness is the main limitation. It can be reduced, however, by land grading, shallow surface drains, and open ditches. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is suited to trees. No hazards or limitations affect planting or harvesting.

This soil generally is unsuitable for building site development and onsite waste disposal because of the flooding. The history of flooding in a given area should be considered when sites for buildings and sanitary facilities are selected.

The land capability classification is I.

89—Sarpy loamy fine sand. This deep, nearly level, excessively drained soil is in the slightly higher areas on the flood plains along the Missouri River. It is protected by levees but still is occasionally flooded by overflow from local tributaries or because of levee breaks. Individual areas are long and narrow and range from 20 to 50 acres in size.

Typically, the surface layer is very dark grayish brown, very friable loamy fine sand about 6 inches thick. The substratum to a depth of about 60 inches is grayish brown fine sand.

Included with this soil in mapping are small areas of the moderately well drained Haynie soils. These soils contain less sand than the Sarpy soil. Also, they are slightly lower on the landscape. They make up about 5 percent of the unit.

Permeability is rapid in the Sarpy soil. Surface runoff is slow. The soil is mildly alkaline throughout. Natural fertility and organic matter content are low. Available water capacity also is low. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for alfalfa. Soybeans or wheat is occasionally grown to reestablish the alfalfa. This soil generally is not suited to cultivated crops because it is droughty. If cultivated crops are grown, irrigation is needed. The soil is suited to alfalfa. The alfalfa should be cut by the early bloom stage and should be at least 6 inches high just before winter. Applications of fertilizer improve the stand.

This soil is suited to trees. Seedling mortality is the main management concern. Selecting a planting stock that is larger than is typical or planting container-grown stock improves the seedling survival rate.

This soil generally is unsuitable for building site development and onsite waste disposal because of the flooding. The history of flooding in a given area should be considered when sites for buildings and sanitary facilities are selected.

The land capability classification is IVs.

90—Wabash silty clay. This deep, nearly level, very poorly drained soil is on flood plains along small streams. It is occasionally flooded. Individual areas are long and narrow and range from 30 to more than 200 acres in size.

Typically, the surface layer is black, firm silty clay about 6 inches thick. The subsurface layer is black, very firm silty clay about 8 inches thick. The subsoil extends to a depth of more than 60 inches. It is black, very firm silty clay in the upper part and very dark gray, very firm silty clay and firm silty clay loam in the lower part. In some areas the surface layer is very dark grayish brown silty clay loam overwash about 10 inches thick. In other areas the soil contains less clay throughout.

Included with this soil in mapping are small areas of the moderately well drained Nodaway soils. These soils are in narrow areas between stream channels and the Wabash soil. They make up about 5 percent of the unit.

Permeability is very slow in the Wabash soil. Surface runoff also is very slow. Reaction is medium acid to mildly alkaline throughout the soil. The pH generally increases with increasing depth. Natural fertility is medium, and organic matter content is moderate. Available water capacity also is moderate. A seasonal high water table is within a depth of 1 foot during winter and spring. The shrink-swell potential is very high. The surface layer is sticky when wet. If tilled when wet, it becomes cloddy and cannot be easily worked when dry. As a result, careful timing of tillage is needed.

Most areas are used for cultivated crops. This soil is suited to soybeans, corn, grain sorghum, and winter wheat. It warms up slowly in the spring and dries out slowly after rains. The wetness is the main limitation. It can be reduced, however, by land grading, shallow surface drains, and open ditches. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface compaction, and increases the rate of water infiltration.

This soil is suited to trees. The equipment limitation, the windthrow hazard, plant competition, and seedling mortality are management concerns. The use of equipment should be limited to periods when the surface is dry or frozen. Ridging the soil and planting larger stock than is typical on the ridges improve the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where the windthrow hazard is slight. Thorough site preparation helps to control plant competition.

This soil generally is unsuitable for building site development and onsite waste disposal because of the flooding and the wetness. The history of flooding in a given area should be considered when sites for buildings and sanitary facilities are selected.

The land capability classification is IIIw.

92—Cotter silt loam. This deep, nearly level, well drained soil is on flood plains along the Missouri River. It is subject to rare flooding. Individual areas are irregular in shape and range from 50 to 100 acres in size.

Typically, the surface layer is black, friable silt loam about 8 inches thick. The subsurface layer also is black, friable silt loam. It is about 12 inches thick. The subsoil is about 20 inches thick. It is friable. The upper part is very dark grayish brown silty clay loam, and the lower part is brown silt loam. The substratum to a depth of about 60 inches is brown and yellowish brown, mottled, friable silt loam.

Included with this soil in mapping are small areas of Haynie, Norborne, and Waldron soils. Haynie and Norborne soils contain more sand than the Cotter soil. Also, Haynie soils are lower on the landscape and closer to the river. Norborne soils are in positions on the landscape similar to those of the Cotter soil. Waldron soils contain more clay than the Cotter soil. Also, they are lower on the landscape. Included soils make up 10 to 15 percent of the unit.

Permeability is moderate in the Cotter soil. Surface runoff is slow. Reaction is strongly acid to slightly acid in the subsoil and varies in the surface layer as a result of local liming practices. Natural fertility is high, and organic matter content is moderate. Available water capacity is very high. The shrink-swell potential is moderate in the subsoil. The surface layer is friable and can be easily tilled throughout a wide range in moisture content. It tends to crust or puddle, however, after hard rains.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and small grain. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is suited to alfalfa, smooth bromegrass, and other grasses and legumes for hay and pasture. If alfalfa is grown, the fertility level should be high. The plants should be cut by the early bloom stage and should be at least 6 inches high just before winter. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth and decreases the rate of water infiltration. Proper stocking rates and pasture rotation improve the pasture.

This soil is suited to trees. Plant competition is the only management concern. It generally can be controlled by thorough site preparation.

This soil is suitable for building site development and onsite waste disposal if the sites are protected from flooding by levees or if the buildings are constructed on raised, well compacted fill material. The shrink-swell potential is a limitation on sites for dwellings and small commercial buildings. Adequately reinforcing the concrete in footings, foundations, and basement walls with steel and backfilling with sand and gravel around the foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The moderate permeability is a limitation in septic tank absorption fields. It can be overcome, however, by enlarging the absorption field. Seepage is a limitation on sites for sewage lagoons. It can be overcome, however, by sealing the lagoon with slowly permeable material.

Low strength, the potential for frost action, and the shrink-swell potential are limitations if this soil is used as a site for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is I.

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 providing 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. The loss of prime farmland to urban and other uses puts pressure on marginal lands, which generally are less productive.

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 cropland, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber or is available for those uses. The soil qualities, growing season, and moisture supply are those needed for a well managed soil economically to produce a sustained high yield of crops. 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. Slopes are mainly 0 to 5 percent, but in a few areas they range to 9 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 37,000 acres in Clay County and 51,000 acres in Ray County meet the soil requirements for prime farmland. An additional 46,000 acres in Clay County and 109,000 acres in Ray County meet the requirements only in areas where the soil is drained. On more than 32,000 acres in Clay County and 38,000 acres in Ray County, the prime farmland occurs as soils on upland ridgetops that have a slope of 2 to 5 percent. The rest occurs as alluvial soils on the flood plains along the Missouri River and its tributaries. Most of the prime farmland is used for cultivated crops. More than 10 percent of the prime farmland in Clay County has been lost to industrial and other urban uses.

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

If a soil meets the requirements for prime farmland only in areas where it is drained, the words "where drained" are added in parentheses after the map unit name in table 5. Onsite investigation is needed to determine whether or not a specific area of the soil is adequately drained. The naturally wet soils in Clay and Ray Counties generally have been adequately drained through the application of drainage measures or because of the incidental drainage that results from farming or other kinds of land development.

Use and Management of the Soils

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

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

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

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

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

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

Crops and Pasture

Calvin D. Phillips and Kenneth B. Holland, district conservationists, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Crops are harvested from about 268,000 acres in Clay and Ray Counties. This acreage includes about 25,000 acres of double cropped wheat and soybeans. About 40,000 acres is used for rotation hay and pasture, 50,000 acres for wheat, 37,000 acres for corn, 134,000 acres for soybeans, and 7,000 acres for grain sorghum.

The acreage used for crops is gradually increasing, mainly because of the conversion of pasture to cropland. The acreage used for commercial, industrial, residential, and other nonagricultural purposes also is increasing, particularly in Clay County. About 80 percent of the land that is converted to urban uses is prime farmland or farmland of statewide importance. According to the 1975 Census of Agriculture, more than 170,000 acres is used for nonagricultural purposes in the two counties.

The main concerns in managing the soils in the counties for crops and pasture are water erosion, wind erosion, fertility, tilth, and drainage.

Water erosion is the major hazard on about 75 percent of the cropland and pasture in Clay and Ray Counties. It is a problem if the slope is more than 2 percent. There are two forms of erosion—sheet and gully. Sheet erosion is more damaging to crops than gully erosion. The loss of the surface layer results in lower fertility, lower available water capacity, lower productivity, poorer tilth, a decreased infiltration rate, and higher energy requirements for tillage. Also, the eroding sediment enters lakes, ponds, and streams and fills roadside ditches and drainage systems. Control of erosion is needed to minimize stream pollution and improve the water quality for domestic, municipal, and recreation uses and for wildlife.

Crop rotations, winter cover crops, a permanent plant cover, conservation tillage, contour farming, contour stripcropping, grassed waterways, tile terrace outlets, terraces, diversions, and grade stabilization structures help to control erosion on upland soils that are suitable for tillage. Crop rotations that include grasses and hay shorten the time that the soil is exposed to the erosion that is likely in cultivated areas. A permanent plant cover, such as grasses and legumes grown for hay or pasture, can reduce soil loss to a negligible amount.

A system of conservation tillage limits the extent to which the surface is disturbed and leaves crop residue on or near the surface. The crop residue increases the rate of water infiltration, improves tilth, and reduces the susceptibility to erosion. It helps to control erosion because it protects the soil from the impact of raindrops. The greater the percentage of ground covered by crop residue, the more effective the erosion control. Examples of conservation tillage are no-till planting and methods of chiseling or disking that leave a protective amount of crop residue on the surface. No-till planting is very effective on sloping soils, including many of the soils in the survey area. Special management is needed, especially in severely eroded areas.

Contour farming and contour stripcropping are effective in controlling erosion on gentle slopes. They are less effective on steep slopes. They are most effective on soils that have smooth, uniform slopes. Terraces and diversions intercept water as it travels downslope and thus help to control erosion. They are most effective on deep, well drained or moderately well drained soils that have uniform slopes. Grassed waterways, tile terrace outlets, and grade stabilization structures help to control gully erosion by disposing of excess water at a nonerosive velocity.

Wind erosion is a minor problem in the two counties. It occurs on sandy soils that are tilled in the fall or are not protected by a cover of plants or crop residue in winter or early in spring. It can be controlled by maintaining a permanent plant cover and by delaying tillage until just prior to planting.

Soil fertility is a basic management concern affecting the productivity of all soils. Natural fertility commonly is high in Haynie, Lagonda, Leta, Macksburg, Nodaway, Sharpsburg, and other soils. On these soils, additions of a moderate amount of nitrogen, phosphate, potash, and calcium are needed. Additions of trace elements also may be needed. Natural fertility is medium or low in Armster, Booker, Greenton, Levasy, and Wabash soils. Heavy applications of fertilizer and lime are needed on these soils. Soil tests are needed to determine the kind and amount of lime and fertilizer that should be applied.

Soil tilth is an important factor affecting seedbed preparation, the germination of seeds, and the infiltration of water into the soil. Organic matter content has an important effect on tilth. The soils that are higher in content of organic matter can be tilled more easily than those in which the content is lower. The soils in areas where severe erosion has removed most of the topsoil and those in areas where frequent tillage has broken down the soil structure are subject to surface crusting. The crust hardens when dry. It reduces the rate of water infiltration and increases the rate of runoff. Returning crop residue to the soil helps maintain the organic matter content, helps to prevent surface crusting, and keeps the soil porous.

Soil drainage is a major management concern on about 90,000 acres in Clay and Ray Counties. It is a concern mainly on the flood plains along the major streams. Aholt, Booker, Leta, Levasy, Parkville, Wabash, Waldron, and Zook are examples of soils in these areas. Because of the slow or very slow permeability in these soils, the wetness damages crops in most years unless a surface drainage system is installed.

Many different kinds of crops and grasses are suited to the soils and climatic conditions in the survey area. Soybeans are the main harvested crops. Corn and grain sorghum also are important row crops. Wheat is the dominant small grain. Oats, rye, and barley are suited to the area but are not widely grown.

The important grasses and legumes grown for hay and pasture are fescue, orchardgrass, bromegrass, timothy, alfalfa, red clover, and lespedeza. Deep-rooted crops, such as alfalfa, are best suited to deep, well drained or moderately well drained soils, such as Armster, Knox, Ladoga, Sharpsburg, and Sibley soils, and to some of the soils in bottom land that are adequately drained.

Native warm-season grasses can grow well in the survey area, but they currently are not widely grown. Big bluestem, indiangrass, and switchgrass are examples of plants that could be included in a grazing system. They produce forage during the hot, dry periods when many cool-season grasses are dormant. These periods are common in July and August.

Apple and peach orchards are suited to the deep, well drained Knox and Sibley soils. Other crops that are not widely grown but have potential in the survey area are potatoes, vegetables, strawberries, and nursery crops.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of the arable soils also is shown in table 6.

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 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit (*16*). 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.

There are no class V or VIII soils in the survey area.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w,* or *s,* 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); and *s* shows that the soil is limited mainly because it is shallow, droughty, or stony. In class I there are no subclasses because the soils of this class have few limitations.

The capability classification of the arable soils is given in the section "Detailed Soil Map Units" and in table 6.

Woodland Management and Productivity

James L. Robinson, forester, Soil Conservation Service, helped prepare this section.

According to a 1972 survey, commercial forest makes up about 8 percent of Clay County and 10 percent of Ray County. Changes in land uses, caused mainly by urban pressure from the Kansas City metropolitan area, have decreased the forest cover.

Most of the timber is in areas of the Knox-Sibley and Snead-Ladoga soil associations, which are described under the heading "General Soil Map Units." These associations are on uplands. The timber type in the uplands is oak-hickory. The Knox soils typically have moderately high potential for commercial trees. The Snead soils have moderate or low potential. The north- and east-facing aspects have the highest potential. In most areas the potential production can be realized only if the woodland is improved. The common trees include white oak, black oak, northern red oak, hickory, and white ash. Quality black walnut may become part of the stands on the Knox soils. The lower quality sites, commonly associated with the Snead soils, support more hickory, winged elm, hackberry, and post oak.

On the Zook-Nodaway-Bremer and Leta-Haynie-Waldron associations, which are on bottom land, the forest cover is in fringe areas along rivers or streams. The soils in these areas are too wet for farming or are not protected from flooding by a levee. The common trees are cottonwood, green ash, silver maple, boxelder, elms, and hackberry. These areas are highly productive timber sites.

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 suitable 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 important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. 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*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; and *f*, high content of coarse fragments in the soil profile. The letter *o* 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.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Ratings of *windthrow hazard* are based on soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that few trees may be blown down by strong winds; *moderate*, that some trees will be blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

Ratings of *plant competition* indicate the degree to which undesirable plants are expected to invade where there are openings in the tree canopy. The invading plants compete with native plants or planted seedlings. A rating of *slight* indicates little or no competition from other plants; *moderate* indicates that plant competition is expected to hinder the development of a fully stocked stand of desirable trees; *severe* indicates that plant competition is expected to prevent the establishment of a desirable stand unless the site is intensively prepared, weeded, or otherwise managed to control undesirable plants.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This 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.

Trees to plant are those that are suited to the soils and to commercial wood production.

Windbreaks and Environmental Plantings

James L. Robinson, forester, Soil Conservation Service, helped prepare this section.

Wind erosion is a hazard on the bottom land in Clay and Ray Counties. It depletes the soil resource and may damage crops. The hazard is most severe in areas of the Leta-Haynie-Waldron soil association, which is described under the heading "General Soil Map Units." Field windbreaks can help to control wind erosion in these areas.

Windbreaks that protect farmsteads from wind and blowing snow are needed most in areas of the Lagonda-Sharpsburg, Sharpsburg-Macksburg, Armster-Lagonda-Sharpsburg, and Grundy-Lagonda associations. Well planned windbreaks reduce the amount of energy needed to heat the home and protect livestock during the cold, windy winter months.

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, the Missouri Department of Conservation, or the Cooperative Extension Service or from a commercial nursery.

Recreation

Edward A. Gaskins, biologist, Soil Conservation Service, helped prepare this section.

The facility inventory part of the 1980 Statewide Comprehensive Outdoor Recreation Plan (SCORP) indicates a total of 25,823 acres of recreational areas in Clay County and 757 acres in Ray County (*13*). Ownership of these areas is 22 percent Federal, 7 percent state, 36 percent municipal, 5 percent school, 23 percent county, 3 percent private, and 4 percent other. The facilities include water sports areas, marinas, golf courses, swimming areas, hunting and fishing areas, campgrounds, bicycle, horseback and hiking trails, game courts, nature study areas, archery and shooting ranges, skating areas, ballfields, picnic areas, playgrounds, horse arenas, interpretive centers, historical sites, fairgrounds, and wildlife viewing areas. The demand for recreational facilities is likely to increase because of a projected substantial increase in population in the survey area by 1990 (*5*).

The new Smithville Lake provides a tremendous increase in opportunities for water-based recreation to the residents of this part of Missouri. Nearly 6,000 acres will be devoted to recreational development. The Smithville Lake dam, just 5 miles north of Kansas City, in an area of Clay County along the Little Platte River near Smithville, will create a 7,190-acre lake having 175 miles of shoreline. When filled to flood capacity, the lake will cover 10,000 acres and will extend 18 miles up the valley to Plattsburg. The project is planned to accommodate 1,400,000 annual visitors and 11,500 people a day each weekend of the summer.

The plan calls for six public parks connected with the reservoir. Four of the parks will be located in Clay County. The areas will provide more than 900 campsites, two organized group camps, swimming beaches, boat marinas, a lodge convention center, nature interpretive programs, golf courses, natural areas, visitor centers, picnic facilities, ballfields, and all types of water sports. Various aquatic habitat developments are planned to improve the lake's fishery, and hunting will be allowed on all government-owned land, except for the areas posted for security and safety purposes. This project, when added to the existing recreational areas, should meet many of the recreation needs of the residents in the two counties.

Watkins Mills State Park, which is more than 1,200 acres in size, is the largest state-owned public recreational area in the two counties. Cooley Lake Wildlife Area, which is 868 acres in size, is second. An additional 12 public areas are more than 100 acres in size, and 18 are less than 100 acres.

According to the 1974 NACD Nationwide Outdoor Recreation Inventory, 40 private and semiprivate commercial recreation enterprises serve the two counties (*10*). They include swimming clubs, day camps, golf courses, riding stables, church camps, a gun club, campgrounds, tennis courts, pay fishing lakes, and a very large amusement park. The Smithville Lake project should create new demands for selected recreational development that can be provided by the private sector.

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

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

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

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have gentle 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 should be considered.

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

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Edward A. Gaskins, biologist, Soil Conservation Service, helped prepare this section.

Clay and Ray Counties are among the 12 counties that make up the Northwest Prairie Zoogeographic Region in Missouri (*9*). Prior to cultivation, about 65 percent of this region was prairie and 35 percent was woodland. In 1981, about 35 percent of the acreage in the two counties was classified as grassland and no significant prairie areas remained. About 36 percent of the acreage was cropland, 21 percent was wooded, and 8 percent was under urban development. The population of the two counties is growing and is likely to increase significantly by 1990 (*5*). Some of the problems affecting wildlife resources are the loss of the habitat base through the conversion to agriculture and urban uses, the enlargement of fields, and the lack of suitable edge growth in the transitional zone between areas covered by different types of vegetation.

Cooley Lake Wildlife Area and the land affected by the Smithville Lake project are the only public hunting lands in the survey area. The vast majority of wildlife habitat is controlled by the private landowner, and obtaining easy access for hunting is becoming more difficult as additional land is posted. The wildlife game species are primarily those that favor openland habitat.

The songbird population is good to excellent in each of the soil associations described under the heading "General Soil Map Units." The furbearer population is good. Raccoon, oppossum, muskrat, coyote, mink, beaver, gray fox, and striped skunk are the principal furbearers trapped in the survey area. A few prairie chickens and badgers remain in Ray County, even though their original grassland habitat is almost nonexistent.

More than 50 percent of the Grundy-Lagonda, Armster-Lagonda-Sharpsburg, Sharpsburg-Macksburg, Lagonda-Sharpsburg, Zook-Nodaway-Bremer, and Leta-Haynie-Waldron associations is cropland or grassland. These associations provide the primary openland wildlife habitat in the two counties. Small tracts of timber, waterways, hedgerows, fence rows, and other areas of woody or brushy cover within these associations provide the edge growth essential for the majority of openland wildlife species. These key habitat areas are fast disappearing in the parts of the counties intensively used for agricultural purposes or urban development. The loss of the plant cover extending into food-producing areas poses a serious threat to openland species.

The quail population is fair and the rabbit population poor in the two counties. The dove population is fair or good. It is enhanced by migratory flights during the hunting season in the fall. No ring-necked pheasants inhabit Clay County. A few are sighted each year in Ray County, but the population is very small.

About 55 percent of the Snead-Ladoga association and 35 percent of the Knox-Sibley association are wooded. These are the only associations in the survey area that have a major percentage of woodland cover. This woodland and the forest cover in the other associations provide the primary habitat for the woodland wildlife species in the two counties. Deer and turkey populations are good in Ray County and are increasing. In Clay County the deer population is fair and the turkey population poor. The available habitat in this county has reached the carrying capacity for these two species. The squirrel population is good to excellent throughout the two counties. The number of woodcock is low. Migratory flights add to this number each year.

Wetland habitat is by far the most scarce of the three major types of wildlife habitat in the survey area. Only the Leta-Haynie-Waldron and Zook-Nodaway-Bremer associations provide any wetland habitat. The soils in these associations are the prime bottom land soils in the survey area. Most have been drained and are intensively farmed. Much of the woodland is too wet for agricultural uses. The few remaining permanent wetlands are in the Mudhole and Jackass Bend areas and in the vicinity of Cooley and Sunshine Lakes. Good populations of snow, blue, and Canadian geese and ducks use the bottom land during periods of high water and the remaining areas of permanent wetland. The wood duck population is good in Ray County and poor or fair in Clay County.

The survey area has about 141 miles of perennial streams (*5*). The Missouri, Crooked, Fishing, and Little Platte Rivers and Fishing, Williams, and Shoal Creeks provide public sport fisheries of one quality or another. The Missouri River is fished commercially for carp, carpsuckers, buffalo flathead, and channel catfish. Walleye, sauger, northern pike, paddlefish, crappie, and white bass are occasionally caught. Bluegill, pumpkinseed, and largemouth bass are caught in the other streams.

The Ray County impoundment fishing for the public is available at the community lake near Richmond, the Lawson City Reservoir, and selected small watershed lakes. In Clay County, the Park Board Lake and Watkins Mill State Park Lake offer access to the public. The new Smithville Lake project offers more than 7,000 acres of fishing water to the public. The principal impoundment species are largemouth bass, channel catfish, bluegill, crappie, and walleye.

Recent estimates indicate about 7,000 farm ponds and small lakes in the survey area have been stocked with fish. These provide opportunities for limited public fishing if permission is obtained from the landowner.

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

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

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

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

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, millet, soybeans, and grain sorghum.

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 soil, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are bluegrass, switchgrass, orchardgrass, indiangrass, clover, alfalfa, trefoil, and crownvetch.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, pokeweed, foxtail, croton, and partridge pea.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, wild plum, sumac, persimmon, and sassafras. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are autumn-olive, crabapple, Amur honeysuckle, and hazelnut.

Coniferous plants furnish winter cover, browse, and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, cutgrass, cattail, rushes, sedges, and buttonbush.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

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

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

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

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

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

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

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

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

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

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

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock 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, and shrink-swell potential can cause the movement of footings. A high water table, depth to bedrock, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

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

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 12 shows the degree and 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, and flooding affect absorption of the effluent. Large stones and bedrock 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, 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 and bedrock 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, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, 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 wind erosion.

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 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; 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. The performance of a system is affected by the depth of the root zone and soil reaction.

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

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

Soil Properties

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

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

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

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

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance (fig. 11). 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.

Figure 11.—Slippage along a roadway in an area where Knox soils were used as fill material.

Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

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

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

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

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

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

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.

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

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

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

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

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

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

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

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

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

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

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

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

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

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

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

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

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

The four hydrologic soil groups are:

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

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

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

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

In table 17, some soils are assigned to two hydrologic groups. 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 or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs, on the average, 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 17 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 17.

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

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

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

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.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*17*). 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 18 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 Udoll (*Ud*, meaning humid, 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 Argiudolls (*Argi*, meaning clay accumulation, plus *udoll*, the suborder of the Mollisols that have a udic 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 *Typic* identifies the subgroup that typifies the great group. An example is Typic Argiudolls.

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-silty, mixed, mesic Typic Argiudolls.

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* (*15*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*17*). 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."

Aholt Series

The Aholt series consists of deep, very poorly drained, very slowly permeable soils on low terraces and flood plains. These soils formed in calcareous, clayey alluvium. Slopes range from 0 to 2 percent.

Aholt soils are similar to Booker soils and commonly are adjacent to the Cotter, Levasy, and Norborne soils. They are slightly lower on the landscape than the adjacent soils. Booker soils are not calcareous. Cotter and Norborne soils contain less clay than the Aholt soils. They are well drained. Levasy soils are underlain by loamy material at a depth of 20 to 38 inches.

Typical pedon of Aholt clay, 660 feet east and 1,980 feet south of the northwest corner of sec. 35, T. 52 N., R. 26 W., Ray County:

Ap—0 to 6 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; strong fine and very fine granular structure; very firm; many fine roots; slightly effervescent; neutral; abrupt smooth boundary.

Bg1—6 to 14 inches; black (10YR 2/1) clay, dark gray (N 4/0) dry; few fine distinct brown (10YR 4/3) mottles; strong very fine angular and subangular blocky structure; very firm; common fine roots; shiny pressure faces; slightly effervescent; mildly alkaline; gradual smooth boundary.

Bg2—14 to 22 inches; very dark gray (10YR 3/1) clay; few fine distinct dark grayish brown (2.5Y 4/2) and brown (10YR 4/3) mottles; moderate medium angular and subangular blocky structure; very firm; few fine roots; few very fine calcium carbonate concretions; shiny pressure faces; strongly effervescent; mildly alkaline; gradual smooth boundary.

Bg3—22 to 34 inches; gray (5Y 5/1) clay; common fine distinct dark grayish brown (2.5Y 4/2) and common fine prominent olive brown (2.5Y 4/4) mottles; moderate medium angular and subangular blocky structure; very firm; few fine calcium carbonate concretions; shiny pressure faces; strongly effervescent; mildly alkaline; gradual smooth boundary.

Bg4—34 to 46 inches; mixed gray (5Y 5/1) and dark gray (5Y 4/1) clay; common fine distinct olive brown (2.5Y 4/4) mottles; weak coarse subangular blocky structure; very firm; few fine calcium carbonate concretions; shiny pressure faces; strongly effervescent; mildly alkaline; clear smooth boundary.

Cg1—46 to 58 inches; gray (5Y 5/1) and (5Y 6/1) silty clay loam; common medium prominent light olive brown (2.5Y 5/4) mottles; massive; firm; strongly effervescent; mildly alkaline; gradual smooth boundary.

Cg2—58 to 66 inches; mottled gray (10YR 5/1) and yellowish brown (10YR 5/6) silty clay loam; massive; firm; strongly effervescent; mildly alkaline.

The thickness of the solum ranges from 45 to 70 inches. The mollic epipedon is 10 to 30 inches thick and includes the upper part of the Bg horizon. The soils are calcareous throughout the control section and range from neutral to moderately alkaline throughout.

The Ap horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. It typically is clay, but the range includes silty clay. The Bg horizon has hue of 2.5Y or 5Y or is neutral in hue. It has value of 2 to 6 and chroma of 0 to 2. Distinct yellowish brown and grayish mottles are below the Ap horizon.

Armster Series

The Armster series consists of deep, moderately well drained, moderately slowly permeable soils on uplands. These soils formed in a thin layer of loess or pedisediment and in the underlying Late Sangamon glacial till. Slopes range from 5 to 20 percent.

Armster soils are similar to Ladoga soils and commonly are adjacent to Greenton, Ladoga, and Snead soils. Greenton and Ladoga soils contain less sand throughout than the Armster soils. Also, Greenton soils are on lower side slopes. Snead soils are moderately deep over bedrock. They are on side slopes below the Armster soils.

Typical pedon of Armster loam, 5 to 9 percent slopes, eroded, 2,375 feet south and 35 feet west of the northeast corner of sec. 22, T. 54 N., R. 29 W., Ray County:

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

BA—6 to 12 inches; brown (7.5YR 4/4) clay loam; mixed with some very dark grayish brown (10YR 3/2) in the top 2 inches; weak very fine subangular blocky structure; friable; many fine roots; few pebbles at the bottom of the horizon; medium acid; clear smooth boundary.

2Bt1—12 to 22 inches; brown (7.5YR 4/4) clay loam; common medium distinct reddish brown (5YR 4/4) mottles; strong fine subangular blocky structure; firm; common fine roots; few distinct dark reddish brown (5YR 3/4) clay films on faces of peds; very strongly acid; clear smooth boundary.

2Bt2—22 to 31 inches; brown (7.5YR 4/4) sandy clay; common medium distinct reddish brown (5YR 4/4) and common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; firm; few fine roots; few distinct dark reddish brown (5YR 3/4) clay films on faces of peds; very strongly acid; clear smooth boundary.

2Bt3—31 to 41 inches; dark yellowish brown (10YR 4/4) sandy clay; common medium distinct strong brown (7.5YR 4/6) and common large distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; strongly acid; gradual smooth boundary.

2Bt4—41 to 52 inches; yellowish brown (10YR 5/4) sandy clay loam; common medium distinct strong brown (7.5YR 4/6) and common large distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; strongly acid; clear smooth boundary.

2C—52 to 60 inches; mixed yellowish brown (10YR 5/4), grayish brown (10YR 5/2), and strong brown (7.5YR 4/6) sandy clay loam; massive; firm; few fine roots;

few black stains of iron and manganese oxides; strongly acid.

The thickness of the solum ranges from 40 to about 90 inches. Reaction is very strongly acid to neutral throughout the profile.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 to 3. It commonly is loam, but it is silt loam in some areas and is clay loam in some eroded areas. The Bt horizon is clay loam, sandy clay, sandy clay loam, or clay. It has hue of 10YR to 5YR. It has value of 4 to 6 and chroma of 4 or 6 in the upper part and value of 5 or 6 and chroma of 4 to 8 in the lower part. The upper part of the argillic horizon has hue of 5YR or redder either in the matrix or in the mottles.

Armster clay loam, 5 to 9 percent slopes, severely eroded, and Armster clay loam, 9 to 20 percent slopes, severely eroded, have a lighter colored surface layer than is definitive for the series. This difference, however, does not significantly affect the use or management of the soils.

Booker Series

The Booker series consists of deep, very poorly drained, very slowly permeable soils on low terraces and flood plains. These soils formed in clayey alluvium. Slopes range from 0 to 2 percent.

Booker soils are similar to Aholt soils and commonly are adjacent to Cotter, Levasy, and Norborne soils. Aholt soils are calcareous. Cotter and Norborne soils are well drained, and are higher on the landscape than the Booker soils. Also, they are less clayey. Levasy soils are underlain by loamy material at a depth of 20 to 38 inches. They are slightly higher on the landscape than the Booker soils.

Typical pedon of Booker silty clay, 120 feet south and 150 feet west of the northeast corner of sec. 36, T. 52 N., R. 27 W., Ray County:

Ap1—0 to 2 inches; black (10YR 2/1) silty clay, gray (10YR 5/1) dry; moderate fine granular structure; very firm; neutral; abrupt smooth boundary.

Ap2—2 to 9 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate fine subangular and angular blocky structure; very firm; common fine roots; neutral; abrupt smooth boundary.

AB—9 to 19 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; very firm; common fine roots; shiny ped surfaces; slightly acid; gradual smooth boundary.

Bg1—19 to 28 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; few fine distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular and angular blocky structure; very firm; few fine roots; few small round concretions of iron and manganese oxides; shiny ped surfaces; medium acid; gradual smooth boundary.

Bg2—28 to 36 inches; very dark grayish brown (2.5Y 3/2) clay, grayish brown (10YR 5/2) dry; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak medium subangular and angular blocky structure; very firm; few small round concretions of iron and manganese oxides; shiny ped surfaces; medium acid; gradual smooth boundary.

Cg1—36 to 42 inches; dark grayish brown (2.5Y 4/2) clay; few fine and medium faint very dark grayish brown (2.5Y 3/2) mottles; massive; very firm; few small round concretions of iron and manganese oxides; slightly acid; gradual smooth boundary.

Cg2—42 to 60 inches; gray (5Y 5/1) clay; few fine and medium distinct very dark grayish brown (2.5Y 3/2) mottles; massive; very firm; few fine concretions of iron and manganese oxides; slightly acid.

The thickness of the solum ranges from 30 to more than 60 inches. The 10- to 40-inch control section is neutral to medium acid.

The Ap horizon has hue of 10YR to 5Y or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. It typically is silty clay, but the range includes clay. The B horizon has hue of 10YR to 5Y or is neutral in hue. It has value of 3 or less and chroma of 2 or less. Distinct mottles with hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 2 to 8 are below a depth of 18 inches. The average clay content in the 10- to 40-inch control section is more than 60 percent. The C horizon has hue of 10YR to 5Y or is neutral in hue. It has value of 4 to 6 and chroma of 2 or less.

Bremer Series

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

Bremer soils are similar to Sampsel soils and commonly are adjacent to Colo, Nodaway, and Wiota soils. Colo soils have a cumulic mollic epipedon and do not have an argillic horizon. They are on first bottoms. Nodaway soils are browner than the Bremer soils, contain less clay, and do not have an argillic horizon. They are on first bottoms. Sampsel soils have a mollic epipedon that is less than 20 inches thick and contain more clay in the B horizon than the Bremer soils. Wiota soils contain less clay in the argillic horizon than the Bremer soils. They are in areas between the Bremer soils and the flood plains.

Typical pedon of Bremer silt loam, 200 feet east and 100 feet north of the southwest corner of sec. 22, T. 52 N., R. 28 W., Ray County:

Ap—0 to 6 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

A—6 to 14 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium granular structure; firm; many fine roots; slightly acid; clear smooth boundary.

Bt—14 to 25 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; few medium faint dark gray (10YR 4/1) mottles; moderate medium subangular blocky structure; firm; common fine roots; few faint clay films on faces of some peds; slightly acid; clear smooth boundary.

Btg—25 to 38 inches; dark gray (10YR 4/1) silty clay loam; common medium distinct dark grayish brown (2.5Y 4/2) and prominent olive brown (2.5Y 4/4) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; slightly acid; gradual smooth boundary.

BCg—38 to 50 inches; gray (10YR 5/1) silty clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; common distinct clay films on faces of peds; slightly acid; gradual smooth boundary.

Cg—50 to 60 inches; gray (10YR 5/1 and 6/1) silty clay loam; few medium prominent yellowish brown (10YR 5/6) mottles; massive; firm; slightly acid.

The thickness of the solum ranges from 40 to 60 inches. The mollic epipedon ranges from 24 to 36 inches in thickness. The soils are dominantly slightly acid or medium acid throughout.

The A horizon is black (10YR 2/1) or very dark gray (N 3/0). It is 14 to 24 inches thick. The Bt horizon has hue of 10YR to 5Y. It has value of 3 in the upper part and value to 4 or 5 in the lower part. The BC horizon and the upper part of the C horizon have hue of 10YR to 5Y, value of 4 or 5, and chroma of 1.

Colo Series

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

Colo soils are similar to Zook soils and commonly are adjacent to Armster, Nodaway, and Zook soils. Armster soils are moderately well drained and are on uplands. Nodaway soils are browner than the Colo soils and contain less clay. They are in areas between the Colo soils and the stream channels. Zook soils have a higher content of clay than the Colo soils.

Typical pedon of Colo silty clay loam, 396 feet west and 330 feet south of the northeast corner of sec. 1, T. 52 N., R. 26 W., Ray County:

Ap—0 to 6 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; few fine roots; medium acid; abrupt smooth boundary.

A1—6 to 17 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak fine granular; firm; few fine roots; slightly acid; gradual smooth boundary.

A2—17 to 28 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; firm; few fine roots; slightly acid; gradual smooth boundary.

Bw—28 to 48 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; few fine faint dark gray (10YR 4/1) mottles; weak fine subangular blocky structure; firm; neutral; gradual smooth boundary.

Cg—48 to 60 inches; very dark gray (10YR 3/1) silty clay loam; few fine faint dark gray (10YR 4/1) mottles; weak very fine subangular blocky structure; firm; few dark grayish brown (10YR 4/2) silt coatings between peds; neutral.

The solum ranges from 36 to 54 inches in thickness. The mollic epipedon is 36 or more inches thick. Reaction is neutral or slightly acid below a depth of 12 inches.

The A horizon has hue of 10YR or 5Y, value of 2 or 3, and chroma of 0 or 1. It is silty clay loam in which the content of clay ranges from 27 to 35 percent. Strong brown and yellowish brown mottles are below a depth of 24 inches in some pedons.

Cotter Series

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

Cotter soils commonly are adjacent to Leta, Norborne, and Waldron soils. Leta soils are clayey in the upper part and loamy in the lower part. They are slightly lower on the landscape than the Cotter soils. Norborne soils contain more sand than the Cotter soils. Their positions on the landscape are similar to those of the Cotter soils. Waldron soils are fine textured. They are slightly lower on the landscape than the Cotter soils.

Typical pedon of Cotter silt loam, 150 feet east and 2,650 feet north of the southwest corner of sec. 11, T. 51 N., R. 27 W., Ray County:

Ap—0 to 8 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak very fine granular structure; friable; many fine roots; slightly acid; abrupt smooth boundary.

A—8 to 20 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate fine granular structure; friable; few fine roots; slightly acid; clear smooth boundary.

Bt1—20 to 30 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; friable; few fine roots; few faint clay films on faces of peds; medium acid; clear smooth boundary.

Bt2—30 to 40 inches; brown (10YR 4/3) silt loam; weak fine subangular blocky structure; friable; few fine roots; dark brown (10YR 3/3) coatings and clay films on faces of peds; strongly acid; clear smooth boundary.

C1—40 to 53 inches; brown (10YR 4/3) silt loam; massive; friable; few fine roots; medium acid; gradual smooth boundary.

C2—53 to 60 inches; yellowish brown (10YR 5/4) silt loam that has thin lenses of silty clay loam; few fine distinct grayish brown (10YR 5/2) mottles; massive; friable; few fine roots; medium acid.

The thickness of the solum ranges from 40 to 60 inches or more. The thickness of the mollic epipedon ranges from 24 to 36 inches. Reaction ranges from mildly alkaline to strongly acid throughout the profile.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The part of the B horizon that is included in the mollic epipedon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. The part of the B horizon below the mollic epipedon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. This horizon is silt loam or silty clay loam. The C horizon is stratified. It has hue cf 10YR, value of 4 to 6, and chroma of 2 to 4. Some pedons have mottles below a depth of 48 inches.

Dockery Series

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

Dockery soils commonly are adjacent to Knox, Leta, and Modale soils. Knox soils have an argillic horizon. They are on uplands above the Dockery soils. Leta soils are clayey in the upper part. They are slightly lower on the landscape than the Dockery soils. Modale soils contain more sand in the upper part and more clay in the lower part than the Dockery soils. Also, they are slightly lower on the landscape.

Typical pedon of Dockery silt loam, 2,490 feet south and 1,250 feet east of the northwest corner of sec. 17, T. 51 N., R. 27 W., Ray County:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate medium and fine granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

C1—8 to 14 inches; very dark grayish brown (10YR 3/2) and grayish brown (2.5Y 5/2) silt loam; appears massive but has weak bedding planes; friable; common fine roots; neutral; gradual smooth boundary.

C2—14 to 19 inches; stratified very dark grayish brown (10YR 3/2) and grayish brown (2.5Y 5/2) silt loam; common medium faint yellowish brown (10YR 5/4) mottles; massive; friable; few fine roots; neutral; gradual smooth boundary.

C3—19 to 36 inches; stratified grayish brown (2.5Y 5/2) and very dark grayish brown (10YR 3/2) silt loam; common medium distinct yellowish brown (10YR 5/4) mottles and stains along strata partings; massive; friable; some thin strata of silty clay loam; neutral; gradual smooth boundary.

C4—36 to 60 inches; stratified very dark gray (5Y 3/1) and grayish brown (2.5Y 5/2) silt loam; common medium prominent yellowish brown (10YR 5/4) mottles and stains, particularly along strata partings; massive; friable; neutral.

The soils are 40 inches to many feet thick. The content of clay in the control section ranges from 18 to 30 percent. Reaction is medium acid to neutral throughout the profile.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. It typically is silt loam, but the range includes silty clay loam. The C horizon has hue of 10YR to 5Y, value of 3 to 5, and chroma of 2 or 3. It is silt loam or silty clay loam. It has mottles with hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 8.

Gilliam Series

The Gilliam series consists of deep, somewhat poorly drained, moderately permeable soils on the flood plains along the Missouri River. These soils formed in silty, calcareous alluvium. Slopes range from 0 to 2 percent.

Gilliam soils commonly are adjacent to Haynie, Leta, Parkville, and Waldron soils. Haynie soils contain less clay than the Gilliam soils. Also, they are slightly higher on the landscape. Leta and Parkville soils are clayey in the upper part. They are slightly lower on the landscape than the Gilliam soils. Waldron soils contain more clay throughout than the Gilliam soils. Also, they are slightly lower on the landscape.

Typical pedon of Gilliam silt loam, 1,400 feet east and 200 feet south of the northwest corner of sec. 3, T. 50 N., R. 31 W., Clay County:

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; friable; neutral; abrupt smooth boundary.

A1—6 to 17 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak very fine platy structure; friable; slightly effervescent; mildly alkaline; abrupt smooth boundary.

A2—17 to 21 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak very fine subangular blocky structure; firm; slightly effervescent; moderately alkaline; abrupt smooth boundary.

C—21 to 27 inches; dark grayish brown (2.5Y 4/2) silt loam; common fine distinct dark brown (10YR 4/3) mottles; massive; friable; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Ab—27 to 43 inches; very dark grayish brown (10YR 3/2) silty clay loam; weak very fine subangular blocky structure; firm; slightly effervescent; moderately alkaline; abrupt smooth boundary.

C1—43 to 51 inches; dark grayish brown (2.5Y 4/2) silt loam; common fine distinct dark brown (10YR 4/3) mottles; massive; friable; strongly effervescent; moderately alkaline; abrupt smooth boundary.

C2—51 to 60 inches; dark grayish brown (10YR 4/2) very fine sand; common medium faint dark brown mottles; massive; loose; slightly effervescent; moderately alkaline.

The thickness of the mollic epipedon ranges from 10 to 24 inches. The content of clay in the 10- to 40-inch control section ranges from 18 to 35 percent. Reaction generally is mildly alkaline or moderately alkaline throughout the profile, but the surface layer may be neutral.

The A or Ap horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. It typically is silt loam, but the range includes silty clay loam and loam. The C horizon is silt loam and silty clay loam and has strata of fine sandy loam and very fine sand. It has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. Strata with value of 2 or 3 and chroma of 1 or 2 are common. The mottles have hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 6.

Greenton Series

The Greenton series consists of deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in thin deposits of loess and in the underlying clay shale and limestone residuum. Slopes range from 5 to 14 percent.

Greenton soils are similar to Grundy soils and commonly are adjacent to Sampsel, Sharpsburg, and Snead soils. Grundy soils contain less clay in the lower part of the B horizon and in the C horizon than the Greenton soils. Sampsel soils have distinct mottles in the lower part of the mollic epipedon. They are on slightly concave foot slopes at the head of drainageways. Sharpsburg and Snead soils are on side slopes above the Greenton soils. Sharpsburg soils do not have mottles with chroma of 2 in the upper part of the argillic horizon. Snead soils are moderately deep.

Typical pedon of Greenton silty clay loam, 5 to 9 percent slopes, eroded, 660 feet south and 198 feet east of the northwest corner of sec. 25, T. 54 N., R. 26 W., Ray County:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; friable; common fine roots; medium acid; abrupt smooth boundary.

Bt1—8 to 11 inches; dark brown (10YR 3/3) silty clay loam, grayish brown (10YR 5/2) dry; moderate very fine subangular blocky structure; friable; common fine roots; few distinct clay films on faces of peds; few fine black concretions of iron and manganese oxides; medium acid; clear smooth boundary.

Bt2—11 to 15 inches; brown (10YR 4/3) silty clay loam; common medium faint dark grayish brown (10YR 4/2) and common fine prominent reddish brown (5YR 4/4) and brown (7.5YR 4/4) mottles; moderate very fine subangular blocky structure; firm; common fine roots; common distinct clay films on faces of peds; few fine black concretions of iron and manganese oxides; medium acid; clear smooth boundary.

Bt3—15 to 22 inches; dark yellowish brown (10YR 4/4) silty clay loam; few fine distinct dark grayish brown (10YR 4/2) mottles; weak fine subangular blocky structure; firm; few fine roots; common distinct dark grayish brown (10YR 4/2) clay films on faces of peds; common fine black stains and concretions of iron and manganese oxides; slightly acid; gradual smooth boundary.

Bt4—22 to 34 inches; brown (10YR 4/3) silty clay loam; common fine distinct grayish brown (10YR 5/2) and common fine faint dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; firm; few fine roots; common faint dark grayish brown (10YR 4/2) clay films on faces of some peds; few fine black concretions of iron and manganese oxides; slightly acid; clear smooth boundary.

2Bt5—34 to 43 inches; mottled grayish brown (10YR 5/2), yellowish brown (10YR 5/6 and 5/4), light brownish gray (10YR 6/2), and dark yellowish brown (10YR 4/4) silty clay; weak very fine subangular blocky structure; very firm; few fine roots; few faint dark grayish brown (10YR 4/2) clay films on faces of some peds; few black stains; slightly acid; clear smooth boundary.

2BC—43 to 49 inches; mottled grayish brown (2.5Y 5/2), light brownish gray (10YR 6/2), yellowish brown (10YR 5/6), and light olive brown (2.5Y 5/4) silty clay; weak fine subangular blocky structure; very firm; few fine roots; few black stains; neutral; abrupt smooth boundary.

2C—49 to 60 inches; mottled light olive brown (2.5Y 5/4), yellowish brown (10YR 5/6), and light brownish gray (2.5Y 6/2) silty clay; massive; very firm; few fine roots; common black stains; neutral.

The thickness of the solum ranges from 36 to 50 inches. The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It typically is silty clay loam, but in some pedons it is silt loam. It is medium acid or slightly acid. The Bt horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 5. It has mottles with chroma of 2 or less within 6 inches of the lower boundary of the mollic epipedon. It is silty clay loam or silty clay and is slightly acid or medium acid. The 2C horizon has hue of 5Y to 10YR, value of 4 to 6, and chroma of 2 to 6. It is clay or silty clay and is neutral to moderately alkaline.

Greenton silty clay loam, 5 to 9 percent slopes, severely eroded, and Greenton silty clay loam, 9 to 14 percent slopes, severely eroded, have a lighter colored surface layer or a thinner dark surface layer than is definitive for the series. This difference, however, does not significantly affect the use or management of the soils.

Grundy Series

The Grundy series consists of deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in loess. Slopes range from 2 to 9 percent.

Grundy soils are similar to Greenton and Lagonda soils and commonly are adjacent to Armster, Lagonda, and Sharpsburg soils. Armster soils have sand and gravel in the lower part of the solum. They are on side slopes below the Grundy soils. Greenton soils contain more clay in the lower part of the B horizon and in the C horizon than the Grundy soils. Lagonda soils contain more sand in the lower part than the Grundy soils. Sharpsburg soils do not have mottles with chroma of 2 in the upper part of the B horizon. They are on ridgetops above the Grundy soils.

Typical pedon of Grundy silt loam, 2 to 5 percent slopes, 60 feet west and 925 feet south of the northeast corner of sec. 5, T. 54 N., R. 28 W., Ray County:

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

A—6 to 15 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak medium granular structure; friable; common fine roots; slightly acid; clear smooth boundary.

Bt1—15 to 22 inches; dark grayish brown (10YR 4/2) silty clay; many medium faint dark brown (10YR 4/3) mottles; moderate very fine subangular blocky structure; very firm; few fine roots; many distinct clay films on faces of peds; strongly acid; clear smooth boundary.

Bt2—22 to 29 inches; dark grayish brown (10YR 4/2) silty clay; common fine faint grayish brown (10YR 5/2), few fine faint brown (10YR 4/3), and common medium prominent brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; firm; few fine roots; many distinct clay films on faces of peds; strongly acid; clear smooth boundary.

Bt3—29 to 36 inches; grayish brown (10YR 5/2) silty clay; common fine prominent strong brown (7.5YR 4/6) and common medium faint brown (10YR 5/3) mottles; weak medium subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; strongly acid; clear smooth boundary.

Bt4—36 to 54 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium prominent strong brown (7.5YR 4/6) and common fine prominent dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; friable; few fine roots; common black stains of iron and manganese oxides; few distinct clay films on faces of peds; slightly acid; gradual smooth boundary.

C—54 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium prominent dark yellowish brown (10YR 4/6) and yellowish red (5YR 4/6) mottles; massive; friable; common black stains; slightly acid.

The mollic epipedon ranges from 11 to 18 inches in thickness. The solum ranges from 40 to 72 inches in thickness. It does not have free carbonates.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is silt loam or silty clay loam. It ranges from medium acid to neutral. The upper part of the Bt horizon has hue of 10YR or 2.5Y, value of 3 or 4, and chroma of 1 to 3. The lower part has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 or 2. This horizon has mottles with hue of 5YR to 10YR, value of 4 or 5, and chroma of 2 to 6. It ranges from strongly acid to neutral. It is silty clay or silty clay loam. The C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It commonly has mottles with chroma of 3 to 8. It is slightly acid or neutral. It is silty clay or silty clay loam.

Grundy silty clay loam, 5 to 9 percent slopes, eroded, has a thinner dark surface layer than is definitive for the series. This difference, however, does not significantly affect the use or management of the soil.

Haynie Series

The Haynie series consists of deep, moderately well drained, moderately permeable soils on the flood plains along the Missouri River. These soils formed in calcareous, silty or loamy alluvium. Slopes range from 0 to 2 percent.

Haynie soils are similar to Nodaway soils and commonly are adjacent to Leta and Sarpy soils. Leta soils are clayey in the upper part. They are slightly lower on the landscape than the Haynie soils. Nodaway soils contain less sand than the Haynie soils and do not have free carbonates. Sarpy soils contain more sand in the 10- to 40-inch control section than the Haynie soils. Also, they are slightly higher on the landscape.

Typical pedon of Haynie silt loam, 1,715 feet west and 2,376 feet north of the southeast corner of sec. 6, T. 50 N., R. 31 W., Clay County:

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

C1—9 to 39 inches; dark grayish brown (10YR 4/2) silt loam; few fine distinct dark yellowish brown (10YR 4/4) and common fine faint grayish brown (10YR 5/2) mottles in the lower part; appears massive but has weak bedding planes; very friable; few fine roots; strongly effervescent; moderately alkaline; abrupt smooth boundary.

C2—39 to 44 inches; dark grayish brown (10YR 4/2) silt loam; few fine distinct dark yellowish brown (10YR 4/4) and few medium faint grayish brown (10YR 5/2) mottles; appears massive but has weak bedding planes; very friable; few fine roots; strongly effervescent; moderately alkaline; abrupt smooth boundary.

C3—44 to 50 inches; grayish brown (10YR 5/2) very fine sandy loam; appears massive but has weak bedding planes; very friable; strongly effervescent; moderately alkaline; clear smooth boundary.

C4—50 to 60 inches; grayish brown (10YR 5/2) loamy fine sand; single grain; loose; strongly effervescent; moderately alkaline.

The thickness of the solum is less than 10 inches. It is the same as the thickness of the Ap or A1 horizon. The control section contains free carbonates throughout.

The A horizon is very dark grayish brown (10YR 3/2 or 2.5Y 3/2). It typically is silt loam, but the range includes very fine sandy loam. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. In some pedons it has mottles with hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 4 to 8. In other pedons it has mottles with value of less than 2 in the lower part. It is dominantly silt loam or very fine sandy loam, but in some pedons it has strata of coarser or finer textured material.

Higginsville Series

The Higginsville series consists of deep, somewhat poorly drained, moderately permeable soils on uplands. These soils formed in silty loess. Slopes range from 5 to 9 percent.

Higginsville soils commonly are adjacent to Nodaway, Sharpsburg, and Sibley soils. Nodaway soils do not have an argillic horizon. They are on small stream bottoms below the Higginsville soils. Sharpsburg and Sibley soils do not have mottles with chroma of 2 within 6 inches of the mollic epipedon. They are on ridgetops above the Higginsville soils and on the ends of ridges adjacent to the Higginsville soils.

Typical pedon of Higginsville silt loam, 5 to 9 percent slopes, 1,340 feet west and 900 feet south of the northeast corner of sec. 3, T. 51 N., R. 31 W., Clay County:

A—0 to 10 inches; very dark brown (10YR 2/2) silt loam, very dark grayish brown dry; moderate fine granular structure; friable; common fine roots; neutral; clear smooth boundary.

BA—10 to 15 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; common fine faint dark grayish brown (10YR 4/2) mottles; moderate very fine subangular blocky structure; friable; common fine roots; slightly acid; clear smooth boundary.

Bt1—15 to 23 inches; mixed dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) silty clay loam; few fine faint dark yellowish brown (10YR 4/4) mottles; moderate fine subangular blocky structure; friable; few fine roots; very dark grayish brown (10YR 3/2) coatings on faces of peds; few black accumulations of iron and manganese oxides in the lower part; strongly acid; clear smooth boundary.

Bt2—23 to 30 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; few fine roots; very dark gray (10YR 3/1) coatings on faces of most peds; black organic stains in root channels; strongly acid; gradual smooth boundary.

Bt3—30 to 41 inches; grayish brown (2.5Y 5/2) silty clay loam; yellowish red (5YR 5/6) stains in root channels and on faces of some peds; moderate medium subangular blocky structure; friable; very dark gray (10YR 3/1) coatings on faces of some peds; black stains in root channels; strongly acid; gradual smooth boundary.

BC—41 to 49 inches; grayish brown (2.5Y 5/2) silty clay loam; common large prominent yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; friable; very dark gray (10YR 3/1) coatings on vertical faces of some peds; black stains in root channels; medium acid; gradual smooth boundary.

C—49 to 60 inches; grayish brown (10YR 5/2) silt loam; common large prominent yellowish brown (10YR 5/6) mottles; massive; friable; dark gray (10YR 4/1) stains in root channels; slightly acid.

The solum is 38 to 54 inches thick. The mollic epipedon is 10 to 24 inches thick.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is dominantly silt loam, but it is silty clay loam in some pedons, especially those in eroded areas. It is medium acid to neutral. The Bt horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 2 or 3. It has mottles with higher value and chroma. The C horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 or 2. It has mottles with hue of 5YR to

10YR, value of 3 to 5, and chroma of 3 to 8. It is silty clay loam or silt loam. The B and C horizons are strongly acid to slightly acid.

Knox Series

The Knox series consists of deep, well drained, moderately permeable soils on uplands adjacent to the flood plains along the Missouri River. These soils formed in silty loess. Slopes range from 5 to 30 percent.

Knox soils are similar to Ladoga soils and commonly are adjacent to Ladoga, Sibley, and Snead soils. Ladoga soils are fine textured. Sibley soils have a cumulic mollic epipedon. They are on the broader ridgetops and side slopes. Snead soils are moderately deep and have a mollic epipedon. They are on side slopes below the Knox soils.

Typical pedon of Knox silt loam, 5 to 9 percent slopes, eroded, 200 feet north and 800 feet east of the center of sec. 5, T. 51 N., R. 27 W., Ray County:

Ap—0 to 7 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak very fine granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

BA—7 to 14 inches; dark yellowish brown (10YR 3/4) silty clay loam; weak fine subangular blocky structure; friable; many fine roots; medium acid; clear smooth boundary.

Bt1—14 to 21 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate fine subangular blocky structure; firm; many fine roots; few distinct dark brown (10YR 3/3) clay films on faces of peds; slightly acid; clear smooth boundary.

Bt2—21 to 29 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate medium subangular blocky structure; firm; many fine roots; common faint dark brown (10YR 3/3) clay films on faces of peds; slightly acid; clear smooth boundary.

Bt3—29 to 40 inches; brown (10YR 4/3) silty clay loam; weak medium subangular blocky structure; friable; common fine roots; slightly acid; gradual smooth boundary.

C—40 to 60 inches; brown (10YR 4/3) silt loam; massive; friable; common fine roots; medium acid.

The thickness of the solum ranges from 36 to more than 60 inches. Reaction ranges from medium acid to neutral throughout the profile, and the depth to free carbonates is more than 60 inches.

The A horizon has hue of 10YR and value and chroma of 2 or 3. It typically is silt loam, but the range includes silty clay loam. The B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is silty clay loam or silt loam. The content of clay in the finest textured part of this horizon ranges from 25 to 35 percent.

Knox silty clay loam, 5 to 14 percent slopes, severely eroded, has a lighter colored surface layer than is definitive for the series. This difference, however, does not significantly affect the use or management of the soil.

Ladoga Series

The Ladoga series consists of deep, moderately well drained, moderately slowly permeable soils on uplands. These soils formed in silty loess. Slopes range from 2 to 14 percent.

Ladoga soils are similar to Armster and Knox soils and commonly are adjacent to Armster, Knox, Sharpsburg, and Snead soils. Armster soils contain more sand throughout than the Ladoga soils. Knox soils are fine-silty. Sharpsburg soils have a mollic epipedon. They are on the broader ridgetops and side slopes above the Ladoga soils. Snead soils are moderately deep. They are on side slopes below the Ladoga soils.

Typical pedon of Ladoga silt loam, 2 to 5 percent slopes, 924 feet south and 1,450 feet west of the northeast corner of sec. 22, T. 53 N., R. 30 W., Clay County:

A—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate very fine granular structure; friable; many fine roots; slightly acid; clear smooth boundary.

E—7 to 11 inches; dark grayish brown (10YR 4/2) silt loam; weak very fine granular structure; friable; common fine roots; slightly acid; clear smooth boundary.

Bt1—11 to 18 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate very fine subangular blocky structure; firm; few fine roots; few faint dark yellowish brown (10YR 3/4) clay films on faces of peds; strongly acid; clear smooth boundary.

Bt2—18 to 28 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate very fine and fine subangular blocky structure; firm; few fine roots; common faint dark yellowish brown (10YR 3/4) clay films on faces of peds; strongly acid; clear smooth boundary.

Bt3—28 to 35 inches; dark yellowish brown (10YR 4/4) silty clay loam; few fine faint brown (10YR 4/3) mottles; moderate fine subangular blocky structure; firm; few roots; common distinct dark yellowish brown (10YR 3/4) clay films on faces of peds; strongly acid; clear smooth boundary.

Bt4—35 to 46 inches; dark yellowish brown (10YR 4/4) silty clay loam; common fine distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few distinct dark yellowish brown (10YR 3/4) clay films on faces of peds; strongly acid; clear smooth boundary.

Bt5—46 to 56 inches; yellowish brown (10YR 5/4) silty clay loam; common medium faint dark yellowish brown (10YR 4/4) and common medium distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; few distinct dark yellowish brown (10YR 3/4) clay films on faces of peds; strongly acid; clear smooth boundary.

C—56 to 60 inches; yellowish brown (10YR 5/4) silty clay loam; few fine distinct dark brown (7.5YR 4/4) and common medium distinct grayish brown (10YR 5/2) mottles; massive; firm; dark yellowish brown (10YR 3/4) coatings on vertical cleavage faces; strongly acid.

The thickness of the solum ranges from 36 to 72 inches. Reaction is medium acid or strongly acid in the most acid part of the profile.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 10YR, value of 4 or 5, and chroma of 2. Some pedons do not have an E horizon. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It has mottles with chroma of 2 in the lower part. It is silty clay loam or silty clay. The C horizon has hue of 10YR, value of 5, and chroma of 3 or 4.

Ladoga silty clay loam, 5 to 14 percent slopes, severely eroded, has a lighter colored surface layer than is definitive for the series. This difference, however, does not significantly affect the use or management of the soil.

Lagonda Series

The Lagonda series consists of deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in a thin layer of loess and in more than 20 inches of weathered pedisediments, which overlie glacial till. Slopes range from 2 to 14 percent.

Lagonda soils are similar to Greenton and Grundy soils and commonly are adjacent to Grundy and Sharpsburg soils. Greenton soils are not so gray in the upper part of the argillic horizon as the Lagonda soils. The content of sand in the lower part of Grundy soils is less than 5 percent. Sharpsburg soils contain less clay than the Lagonda soils and do not have mottles with chroma of 2 in the upper part of the B horizon. They are on ridgetops and side slopes above the Lagonda soils.

Typical pedon of Lagonda silt loam, 2 to 5 percent slopes, 400 feet east and 15 feet south of the northwest corner of sec. 35, T. 54 N., R. 27 W., Ray County:

Ap—0 to 6 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; moderate very fine granular structure; friable; many fine roots; medium acid; abrupt smooth boundary.

A—6 to 15 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; firm; many fine roots; medium acid; clear smooth boundary.

Bt1—15 to 23 inches; dark grayish brown (10YR 4/2) silty clay; common fine distinct dark yellowish brown (10YR 4/4) mottles; moderate very fine subangular blocky structure; very firm; common fine roots; common distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; medium acid; gradual smooth boundary.

Bt2—23 to 32 inches; dark grayish brown (10YR 4/2) silty clay; common fine distinct dark yellowish brown (10YR 4/4) mottles; moderate fine subangular blocky structure; firm; few fine roots; common faint dark grayish brown (10YR 4/2) clay films on faces of peds; medium acid; clear smooth boundary.

2Bt3—32 to 43 inches; grayish brown (10YR 5/2) silty clay loam; common medium distinct brown (7.5YR 4/4) mottles; moderate fine angular blocky structure; firm; few fine roots; common faint clay films on faces of peds; few fine sand grains; neutral; clear smooth boundary.

2Bt4—43 to 55 inches; grayish brown (10YR 5/2) silty clay loam; few medium distinct yellowish brown (10YR 5/4) and gray (10YR 6/1) mottles; weak medium subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; few fine sand grains; neutral; gradual smooth boundary.

2C—55 to 60 inches; mottled gray (10YR 6/1), brown (10YR 4/3), and yellowish brown (10YR 5/6) silty clay loam; massive; friable; few fine roots; common fine concretions of iron and manganese oxides; few sand grains; neutral.

The thickness of the solum ranges from 40 to 60 inches. The thickness of the mollic epipedon ranges from 10 to 24 inches. The depth to a marked increase in content of sand ranges from 20 to 36 inches.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It typically is silt loam or silty clay loam. It is medium acid or slightly acid. The Bt, 2B, and 2C horizons are silty clay loam or silty clay. The Bt horizon has hue of 10YR or 2.5Y, value of 3 or 4, and chroma of 2 to 4. It is medium acid to neutral. The 2B horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 to 3. It is neutral or mildly alkaline. The content of sand in this horizon is more than 10 percent. The 2C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is neutral to moderately alkaline.

Lagonda silty clay loam, 5 to 9 percent slopes, eroded, and Lagonda silty clay loam, 5 to 9 percent slopes, severely eroded, have a thinner dark surface layer than is definitive for the series. This difference, however, does not significantly affect the use or management of the soils.

Landes Series

The Landes series consists of deep, well drained soils on the flood plains along the Missouri River. These soils formed in loamy and sandy alluvium. Permeability is moderately rapid in the upper part of the profile and rapid in the lower part. Slopes range from 0 to 2 percent.

Landes soils commonly are adjacent to Haynie, Leta, and Parkville soils. They are slightly higher on the landscape than the adjacent soils. Haynie soils are coarse-silty. Leta and Parkville soils are clayey in the upper part and loamy in the lower part.

Typical pedon of Landes fine sandy loam, 1,600 feet south and 140 feet east of the northwest corner of sec. 9, T. 51 N., R. 26 W., Ray County:

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

A1—6 to 11 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; moderate fine and medium granular structure; friable; many fine roots; neutral; clear smooth boundary.

A2—11 to 18 inches; dark brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; moderate medium platy structure parting to weak very fine granular; friable; common fine roots; common fine pores and old root channels; neutral; gradual smooth boundary.

Bw—18 to 27 inches; brown (10YR 4/3) fine sandy loam, pale brown (10YR 6/3) dry; weak very fine subangular blocky structure; friable; common fine roots and old root channels; neutral; clear smooth boundary.

C1—27 to 35 inches; brown (10YR 5/3) loamy fine sand; common medium distinct brownish yellow (10YR 6/6) mottles; massive; friable; common fine roots; common fine pores; slightly effervescent; mildly alkaline; abrupt smooth boundary.

C2—35 to 68 inches; stratified brown (10YR 5/3) and light brownish gray (10YR 6/2) loamy fine sand; a layer of dark grayish brown (10YR 4/2) silty clay loam about 1 inch thick; single grain; loose; slightly effervescent; mildly alkaline.

The mollic epipedon ranges from 10 to 24 inches in thickness. The solum ranges from slightly acid to moderately alkaline.

The A horizon has hue of 10YR and value and chroma of 2 or 3. It is dominantly fine sandy loam, but the range includes sandy loam and very fine sandy loam. The Bw horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is dominantly fine sandy loam, but the range includes sandy loam and very fine sandy loam. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 3 or more. It is sand, loamy fine sand, or loamy sand. In some pedons it has thin strata of finer textured material.

Leta Series

The Leta series consists of deep, somewhat poorly drained soils on the flood plains along the Missouri River. These soils formed in clayey alluvium 20 to 38 inches deep over loamy alluvium. Permeability is slow in the upper part of the profile and moderate in the lower part. Slopes range from 0 to 2 percent.

Leta soils are similar to Parkville soils and commonly are adjacent to Cotter, Haynie, Levasy, and Parkville soils. Cotter and Haynie soils are not clayey in the upper part. They are slightly higher on the landscape than the Leta soils. Levasy soils are poorly drained and are in slightly depressional areas. Parkville soils formed in clayey alluvium 12 to 20 inches deep over loamy alluvium.

Typical pedon of Leta silty clay, 2,620 feet south and 50 feet west of the northeast corner of sec. 26, T. 51 N., R. 31 W., Clay County:

Ap—0 to 5 inches; very dark gray (10YR 3/1) silty clay, grayish brown (10YR 5/2) dry; weak very fine granular structure; very firm; few fine roots; slightly effervescent; mildly alkaline; abrupt smooth boundary.

A—5 to 14 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; weak medium subangular blocky structure; very firm; few fine roots; slightly effervescent; mildly alkaline; gradual smooth boundary.

Bw1—14 to 22 inches; dark grayish brown (2.5Y 4/2) silty clay; moderate very fine subangular blocky structure; very firm; few fine roots; very dark grayish brown (2.5Y 3/2) organic stains on faces of peds; slightly effervescent; mildly alkaline; clear smooth boundary.

Bw2—22 to 34 inches; dark grayish brown (2.5Y 4/2) silty clay; few fine distinct dark yellowish brown (10YR 4/4) mottles; moderate medium angular blocky structure; very firm; few very fine roots; slightly effervescent; mildly alkaline; abrupt smooth boundary.

2C—34 to 60 inches; stratified light olive brown (2.5Y 5/4), dark grayish brown (2.5Y 4/2), and grayish brown (10YR 5/2) silt loam and very fine sandy loam; massive; friable; few very fine roots; slightly effervescent; mildly alkaline.

The thickness of the solum ranges from 20 to 38 inches and is the same as the thickness of the clayey upper part of the profile. The mollic epipedon ranges from 10 to 20 inches in thickness. The soils have free carbonates throughout and are mildly alkaline or moderately alkaline.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It has mottles with higher chroma in the lower part. The solum is silty clay loam or silty clay in which the content of clay ranges from 35 to 48 percent. The 2C horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 1 or 2. It has mottles with hue of 10YR, 7.5YR, or 5YR, value of 4 to 6, and chroma of 4 to 8. It commonly is stratified silt loam and very fine sandy loam. In some pedons it has thin strata of finer or coarser textured material.

Levasy Series

The Levasy series consists of deep, poorly drained soils on bottom land along the Missouri River. These soils formed in clayey alluvium 20 to 38 inches deep over loamy alluvium. Permeability is slow in the upper part of the profile and moderate in the lower part. Slopes range from 0 to 2 percent.

Levasy soils are similar to Myrick soils and commonly are adjacent to Haynie, Leta, and Myrick soils. The moderately well drained Haynie and somewhat poorly drained Leta soils are slightly higher on the landscape than the Levasy soils. Haynie soils are silty or loamy throughout. Myrick soils are slightly lower on the landscape than the Levasy soils. Also, they have thinner clayey horizons.

Typical pedon of Levasy silty clay, 1,980 feet north and 2,000 feet west of the southeast corner of sec. 10, T. 51 N., R. 27 W., Ray County:

Ap—0 to 6 inches; very dark gray (10YR 3/1) silty clay, very dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak very fine granular; very firm; few fine roots; slightly effervescent; mildly alkaline; abrupt smooth boundary.

A—6 to 14 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; weak fine subangular blocky structure parting to weak fine granular; very firm; few fine roots; slightly effervescent; mildly alkaline; clear smooth boundary.

Bg1—14 to 24 inches; dark grayish brown (2.5Y 4/2) silty clay; common fine distinct olive brown (2.5Y 4/4) mottles; moderate fine angular blocky structure; very firm; few fine roots; slightly effervescent; mildly alkaline; clear smooth boundary.

Bg2—24 to 32 inches; dark grayish brown (2.5Y 4/2) silty clay; few fine distinct olive brown (2.5Y 4/4) mottles; weak fine angular blocky structure; very firm; slightly effervescent; mildly alkaline; abrupt smooth boundary.

2Cg1—32 to 46 inches; dark grayish brown (2.5Y 4/2) silt loam; common fine distinct olive brown (2.5Y 4/4) mottles; appears massive but has weak bedding planes; friable; strongly effervescent; moderately alkaline; clear smooth boundary.

2Cg2—46 to 60 inches; dark grayish brown (2.5Y 4/2) very fine sandy loam; common fine distinct olive brown (2.5Y 4/4) mottles; appears massive but has weak bedding planes; very friable; strongly effervescent; moderately alkaline.

The thickness of the mollic epipedon ranges from 10 to 24 inches. The clayey A horizon is underlain by loamy deposits at a depth of 20 to 38 inches. The soils have free carbonates throughout and are mildly alkaline or moderately alkaline.

The Ap horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. The A1 horizon has hue of 10YR to 5Y, value of 2 to 4, and chroma of 1 or 2. The A horizon commonly is silty clay, but the range includes clay and silty clay loam. The B2 horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 or 5, and chroma of 1 or 2. The 2C horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 or 2. It is fine sandy loam, loam, very fine sandy loam, or silt loam.

Macksburg Series

The Macksburg series consists of deep, somewhat poorly drained, moderately slowly permeable soils on uplands. These soils formed in loess. Slopes range from 5 to 9 percent.

Macksburg soils are similar to Grundy and Lagonda soils and commonly are adjacent to Nodaway and Sharpsburg soils. Grundy and Lagonda soils contain more clay in the Bt horizon than the Macksburg soils. Nodaway soils are silty throughout. They are on flood plains along small streams below the Macksburg soils. Sharpsburg soils do not have mottles with chroma of 2 in the upper part of the B horizon. They are on ridgetops above the Macksburg soils and on the ends of ridges adjacent to the Macksburg soils.

Typical pedon of Macksburg silt loam, 5 to 9 percent slopes, 1,518 feet west and 2,310 feet north of the southeast corner of sec. 36, T. 52 N., R. 31 W., Clay County:

Ap—0 to 7 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; many fine roots; common fine pores and old root channels; neutral; clear smooth boundary.

A—7 to 13 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium granular structure; friable; many fine roots; common fine pores and old root channels; slightly acid; clear smooth boundary.

AB—13 to 19 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to moderate medium granular; friable; many fine roots; common fine pores and old root channels; slightly acid; clear smooth boundary.

Bt1—19 to 25 inches; dark grayish brown (10YR 4/2) silty clay loam; common fine faint brown (10YR 5/3) and (10YR 4/3) mottles; moderate very fine subangular blocky structure; firm; common fine roots; few distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; few black stains and concretions of iron and manganese oxides; medium acid; clear smooth boundary.

Bt2—25 to 31 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine faint dark grayish brown (2.5Y 4/2) and common fine distinct olive brown (2.5Y 4/4) mottles; weak fine subangular blocky structure; firm; few fine roots; common distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; common black stains and concretions of iron and manganese oxides; medium acid; gradual smooth boundary.

Bt3—31 to 48 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium distinct olive brown (2.5Y 4/4) and common medium faint light brownish gray (2.5Y 6/2) mottles; weak medium subangular blocky structure; firm; few fine roots; few distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; common black stains and concretions of iron and manganese oxides; medium acid; gradual smooth boundary.

C—48 to 61 inches; grayish brown (2.5Y 5/2) silty clay loam; few medium prominent strong brown (7.5YR 4/6) and common fine faint dark grayish brown (2.5Y 4/2) and light brownish gray (2.5Y 6/2) mottles; massive; friable; medium acid.

The thickness of the solum ranges from 48 to more than 60 inches. Reaction typically is medium acid or strongly acid in the A and B horizons and slightly acid or neutral in the C horizon.

The A horizon has hue of 10YR, value of 2, and chroma of 1 or 2. It is silt loam and silty clay loam. The content of clay in this horizon ranges from 25 to 34 percent. The upper part of the Bt horizon typically is dark grayish brown (10YR 4/2), but colors with hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4 are common. The lower part of the Bt horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 2 to 4. The Bt horizon is silty clay loam or silty clay. The content of clay in this horizon ranges from 36 to 42 percent. The C horizon has hue of 5Y to 7.5YR, value of 4 to 6, and chroma of 2 to 6. It is silty clay loam or silt loam.

Modale Series

The Modale series consists of deep, somewhat poorly drained soils on bottom land along the Missouri River. These soils formed in recently deposited silty or loamy alluvium over an older clayey alluvium. Permeability is moderate in the upper part of the profile and slow in the lower part. Slopes range from 0 to 2 percent.

Modale soils commonly are adjacent to Haynie, Leta, and Waldron soils. Haynie soils are silty or loamy throughout. They are slightly higher on the landscape than the Modale soils. Leta and Waldron soils have a clayey surface layer. They are slightly lower on the landscape than the Modale soils.

Typical pedon of Modale silt loam, 1,200 feet east and 1,200 feet north of the southwest corner of sec. 27, T. 51 N., R. 31 W., Clay County:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; friable; few very fine roots; neutral; abrupt smooth boundary.

C1—9 to 20 inches; dark grayish brown (10YR 4/2) very fine sandy loam; common medium faint brown (10YR 4/3) and few fine distinct dark yellowish brown (10YR 4/6) mottles; massive; very friable; slightly effervescent; mildly alkaline; abrupt smooth boundary.

2C2—20 to 27 inches; very dark grayish brown (10YR 3/2) silty clay; few fine distinct dark yellowish brown (10YR 4/6) mottles; weak medium subangular blocky structure; very firm; dark grayish brown (10YR 4/2) silt loam in old cracks and root channels; mildly alkaline; clear smooth boundary.

2C3—27 to 43 inches; dark grayish brown (10YR 4/2) silty clay; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine angular blocky structure; very firm; slightly effervescent; moderately alkaline; abrupt smooth boundary.

2C4—43 to 60 inches; stratified dark grayish brown (2.5Y 4/2) silty clay and light brownish gray (10YR 6/2) silt loam; common fine distinct dark yellowish brown (10YR 4/4) and few fine distinct light olive brown (2.5Y 5/6) mottles; weak fine angular blocky structure in the strata of silty clay; very firm; strongly effervescent; moderately alkaline.

The thickness of the solum is less than 10 inches and is the same as the thickness of the A1 or Ap horizon. The upper 18 to 30 inches is silt loam or very fine sandy loam, and the lower part is silty clay or clay. Free carbonates generally are throughout the profile. In some pedons, however, they do not occur in the A horizon or the darker strata.

The A horizon typically is very dark grayish brown (10YR 3/2 or 2.5Y 3/2) but in some pedons is very dark gray (10YR 3/1) or dark grayish brown (10YR 4/2 or 2.5Y 4/2). It typically is silt loam, but the range includes very fine sandy loam. The C1 horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It has mottles with hue of 10YR, 2.5Y, or 5Y, value of 3 to 6, and chroma of 1 to 8. It is silt loam or very fine sandy loam. The 2C horizon is clay or silty clay and is mildly alkaline or moderately alkaline. It either is neutral in hue or has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 or 2. Except for a few scattered strata in the lower part, only the upper 10 inches or less of the horizon has value of 3.

Moniteau Series

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

Moniteau soils are adjacent to Armster, Nodaway, and Snead soils. Armster soils contain more sand in the solum than the Moniteau soils. They are on uplands. Nodaway soils do not have an argillic horizon and contain less clay than the Moniteau soils. Also, they are closer to the streams. Snead soils are moderately deep and have a clayey B horizon. They are on uplands.

Typical pedon of Moniteau silt loam, 2,760 feet south and 1,775 feet east of the northwest corner of sec. 10, T. 54 N., R. 29 W., Ray County:

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) dry; moderate very fine granular structure; friable; many fine roots; slightly acid; abrupt smooth boundary.

E—7 to 16 inches; grayish brown (10YR 5/2) silt loam; weak thin platy structure parting to weak very fine granular; friable; many fine roots; slightly acid; abrupt smooth boundary.

Btg1—16 to 29 inches; grayish brown (10YR 5/2) silty clay loam; few fine distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; firm; common fine roots; few prominent dark grayish brown (10YR 4/2) clay films on faces of peds; very strongly acid; clear smooth boundary.

Btg2—29 to 36 inches; mottled grayish brown (10YR 5/2), light brownish gray (10YR 6/2), and dark brown (7.5YR 4/4) silty clay loam; moderate medium subangular blocky structure; firm; common fine roots; few prominent dark grayish brown (10YR 4/2) clay films on faces of peds; strongly acid; clear smooth boundary.

Btg3—36 to 48 inches; mottled grayish brown (10YR 5/2), light brownish gray (10YR 6/2), and yellowish brown (10YR 5/6) silty clay loam; moderate medium angular blocky structure; firm; few fine roots; few faint grayish brown (10YR 5/2) clay films on faces of peds; strongly acid; gradual smooth boundary.

Btg4—48 to 59 inches; light brownish gray (10YR 6/2) silty clay loam; common medium distinct yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; firm; few fine roots; few faint grayish brown (10YR 5/2) coatings on faces of some peds; strongly acid; gradual smooth boundary.

Cg—59 to 64 inches; light brownish gray (10YR 6/2) silty clay loam; common medium distinct yellowish brown (10YR 5/4) mottles; massive; firm; few fine roots; some vertical cleavage; grayish brown (10YR 5/2) coatings on some cleavage faces; strongly acid.

The solum ranges from 36 to 70 inches in thickness. The A1 or Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. The E has hue of 10YR, value of 5 to 7, and chroma of 1 or 2. The Bt horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It has mottles with higher chroma. It ranges from medium acid to very strongly acid.

Myrick Series

The Myrick series consists of deep, poorly drained soils on bottom land along the Missouri River. These soils formed in clayey alluvium 12 to 20 inches deep over loamy alluvium. They are slowly permeable in the upper part and moderately permeable in the lower part. Slopes range from 0 to 2 percent.

Myrick soils are similar to Levasy soils and commonly are adjacent to Haynie, Leta, and Levasy soils. They are slightly lower on the landscape than the adjacent soils. Haynie soils do not have a clayey surface layer. Leta and Levasy soils formed in clayey material 20 to 38 inches deep over loamy material.

Typical pedon of Myrick silty clay loam, 775 feet east and 300 feet south of the center of sec. 3, T. 50 N., R. 28 W., Ray County:

Ap—0 to 4 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; firm; few fine roots; slightly effervescent; mildly alkaline; abrupt smooth boundary.

A—4 to 13 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate fine angular blocky structure; very firm; few fine roots; grayish brown (10YR 5/2) silt coatings between some peds; slightly effervescent; mildly alkaline; abrupt smooth boundary.

2Cg—13 to 60 inches; grayish brown (2.5Y 5/2) stratified very fine sandy loam and silt loam; common medium faint gray (10YR 5/1) and few fine distinct brown (10YR 4/3) mottles; massive; very friable; yellowish brown (10YR 5/6) stains around old root channels; strongly effervescent; moderately alkaline.

The solum and the mollic epipedon range from 12 to 20 inches in thickness. The soils are calcareous throughout.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. It is silty clay loam or silty clay. Some pedons have fine textured horizons below the mollic epipedon. These horizons have hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. The 2C horizon has value of 5 or 6 and chroma of 2 or less. It has mottles with higher chroma.

Nodaway Series

The Nodaway series consists of deep, moderately well drained, moderately permeable soils on flood plains or alluvial fans along tributary streams of the Missouri River.

These soils formed in recent silty alluvium. Slopes range from 0 to 2 percent.

Nodaway soils are similar to Haynie soils and commonly are adjacent to Bremer, Colo, Wabash, and Zook soils in the landscape. The adjacent soils have a mollic epipedon and contain more clay than the Nodaway soils. The poorly drained Bremer soils are on terraces. The poorly drained Colo and Zook and very poorly drained Wabash soils are in depressional or nearly level areas farther from the stream channels than the Nodaway soils. Haynie soils are calcareous.

Typical pedon of Nodaway silt loam, 1,050 feet east and 2,510 feet south of the northwest corner of sec. 8, T. 54 N., R. 29 W., Ray County:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

C1—8 to 28 inches; stratified very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) silt loam; massive; friable; few fine roots; common wormholes and wormcasts; neutral; abrupt smooth boundary.

C2—28 to 60 inches; dark grayish brown (10YR 4/2) silt loam; appears massive but has weak bedding planes; friable; few fine roots; common wormholes and wormcasts; neutral; clear smooth boundary.

The Ap horizon has value of 3 and chroma of 1 or 2. The C horizon generally has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. In some pedons where it occurs as stratified sediments, however, it is as dark as very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). It is slightly acid or neutral. It typically is silt loam or loam, but in some pedons it is silty clay loam in which the content of clay is about 28 percent.

Norborne Series

The Norborne series consists of deep, well drained, moderately permeable soils in the slightly higher areas on the flood plains along the Missouri River. These soils formed in loamy, stratified alluvium. Slopes range from 0 to 2 percent.

Norborne soils commonly are adjacent to Cotter and Leta soils. Cotter soils contain less sand in the control section than the Norborne soils. Their positions on the landscape are similar to those of the Norborne soils. Leta soils are somewhat poorly drained and are lower on the landscape than the Norborne soils. They have a clayey A horizon.

Typical pedon of Norborne very fine sandy loam, 400 feet east and 2,700 feet north of the southwest corner of sec. 6, T. 50 N., R. 28 W., Ray County:

Ap—0 to 9 inches; very dark brown (10YR 2/2) very fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; common fine roots; medium acid; abrupt smooth boundary.

A—9 to 17 inches; very dark brown (10YR 2/2) very fine sandy loam, dark grayish brown (10YR 4/2) dry; weak very fine granular structure; very friable; common fine roots; slightly acid; clear smooth boundary.

Bt1—17 to 25 inches; very dark brown (10YR 2/2) very fine sandy loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; friable; common fine roots; few faint clay films on faces of peds; slightly acid; clear smooth boundary.

Bt2—25 to 34 inches; dark brown (10YR 3/3) very fine sandy loam, brown (10YR 4/3) dry; moderate fine subangular blocky structure; friable; common fine roots; few faint clay films on faces of peds; slightly acid; clear smooth boundary.

Bt3—34 to 45 inches; brown (10YR 4/3) very fine sandy loam; weak coarse subangular blocky structure; very friable; common fine roots; few faint clay films on faces of peds; slightly acid; gradual smooth boundary.

C—45 to 60 inches; brown (10YR 4/3) very fine sandy loam; few fine faint dark yellowish brown (10YR 4/4) and common medium faint grayish brown (10YR 5/2) mottles; massive; very friable; few fine roots; slightly acid.

The thickness of the solum ranges from 42 to 60 inches or more. The mollic epipedon is more than 24 inches thick and extends into the B horizon. Reaction ranges from neutral to medium acid throughout the profile.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. It typically is very fine sandy loam, but the range includes loam. The Bt horizon has hue of 10YR and value and chroma of 2 or 3 in the upper part and has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4 in the lower part. It is very fine sandy loam, loam, or silt loam. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. Yellowish brown and grayish brown mottles are common below a depth of 30 inches.

Parkville Series

The Parkville series consists of deep, somewhat poorly drained soils on the flood plains along the Missouri River. Permeability is very slow in the upper part of the profile and moderate in the lower part. These soils formed in calcareous, clayey alluvium 12 to 20 inches deep over calcareous, loamy alluvium. Slopes range from 0 to 2 percent.

Parkville soils are similar to Leta soils and commonly are adjacent to Haynie, Leta, and Levasy soils. Haynie soils are silty or loamy throughout. They are slightly higher on the landscape than the Parkville soils. Leta soils are slightly lower on the landscape than the Parkville soils. Also, their clayey A horizon is thicker. Levasy soils are poorly drained and are in slight depressions. Their clayey A horizon is thicker than that of the Parkville soils.

Typical pedon of Parkville silty clay, 1,980 feet west and 40 feet south of the northeast corner of sec. 28, T. 51 N., R. 27 W., Ray County:

Ap—0 to 5 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate fine granular structure; firm; few fine roots; neutral; abrupt smooth boundary.

A1—5 to 15 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate fine angular blocky structure; very firm; few fine roots; neutral; clear smooth boundary.

A2—15 to 19 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; very firm; slightly effervescent; neutral; abrupt wavy boundary.

2C1—19 to 35 inches; brown (10YR 4/3) silt loam; few medium distinct grayish brown (10YR 5/2) and few fine prominent strong brown (7.5YR 5/6) mottles; massive; very friable; few strata of very fine sand; strongly effervescent; neutral; clear smooth boundary.

2C2—35 to 72 inches; grayish brown (10YR 5/2) silt loam; common medium distinct yellowish brown (10YR 5/6) mottles; massive; very friable; strong brown (7.5YR 5/6 to 5/8) stains along old root channels; few fine lime concretions; strongly effervescent; moderately alkaline.

The thickness of the solum ranges from 12 to 20 inches. The mollic epipedon ranges from 10 to 20 inches in thickness. Reaction ranges from neutral to moderately alkaline in the upper part of the profile and is mildly alkaline or moderately alkaline in the lower part.

The A1 or Ap horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 to 3. It typically is silty clay, but the range includes silty clay loam. The 2C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 or 3. It is silt loam, loamy very fine sand, or very fine sandy loam and has strata of coarser or finer textured material.

Sampsel Series

The Sampsel series consists of deep, poorly drained, slowly permeable soils on uplands, on foot slopes, and at the head of drainageways. These soils formed in shale residuum. Slopes range from 2 to 9 percent.

Sampsel soils are similar to Bremer soils and commonly are adjacent to Greenton, Grundy, and Snead soils. Bremer soils have a mollic epipedon that is more than 24 inches thick. Greenton, Grundy, and Snead soils do not have distinct mottles in the lower part of the mollic epipedon. They are higher on the landscape than the Sampsel soils. Greenton soils are on convex side slopes. Grundy soils are on ridgetops or side slopes. The moderately deep Snead soils are on the steeper side slopes.

Typical pedon of Sampsel silty clay loam, 5 to 9 percent slopes, 1,518 feet east and 726 feet south of the northwest corner of sec. 35, T. 53 N., R. 28 W., Ray County:

Ap—0 to 5 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; common fine roots; medium acid; abrupt smooth boundary.

A—5 to 9 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; few fine roots; medium acid; clear smooth boundary.

BA—9 to 15 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; common fine distinct brown (10YR 4/3) and dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; firm; few fine roots; medium acid; clear smooth boundary.

Bt1—15 to 31 inches; dark grayish brown (10YR 4/2) silty clay loam; common fine distinct dark yellowish brown (10YR 4/4) and common fine faint dark gray (10YR 4/1) mottles; moderate very fine subangular blocky structure; firm; few fine roots; common faint very dark gray (10YR 3/1) clay films on faces of peds; few black iron stains; medium acid; gradual smooth boundary.

Bt2—31 to 42 inches; dark grayish brown (2.5Y 4/2) silty clay; many fine distinct olive brown (2.5Y 4/4) and common fine faint very dark gray (N 3/0) mottles; moderate very fine subangular blocky structure; very firm; few fine roots; common faint dark gray (N 4/0) and very dark gray (N 3/0) clay films on faces of peds; common black soft accumulations of iron and manganese oxides; medium acid; gradual smooth boundary.

Bt3—42 to 49 inches; dark grayish brown (2.5Y 4/2) silty clay loam; common medium distinct olive brown (2.5Y 4/4) and common fine faint dark gray (N 4/0) mottles; moderate fine subangular blocky structure; firm; few fine roots; many distinct very dark gray (N 3/0) clay films on faces of peds; common black soft accumulations of iron and manganese oxides; slightly acid; gradual smooth boundary.

Bt4—49 to 60 inches; mottled dark grayish brown (2.5Y 4/2), dark gray (N 4/0), and olive brown (2.5Y 4/4) silty clay loam; weak fine subangular blocky structure; firm; few faint clay films on faces of some peds; common black soft accumulations of iron and manganese oxides; slightly acid.

The thickness of the solum ranges from 36 to 70 inches. The depth to bedrock ranges from 40 to 70 inches. The mollic epipedon is 10 to 20 inches thick. Reaction is mildly alkaline to medium acid throughout the profile.

The A and BA horizons have hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. The Ap horizon typically is silty clay loam, but the range includes silt loam. The Bt horizon has hue of 10YR to 5Y, value of 3 to 6, and chroma of 1 or 2. It has mottles with higher chroma. It is silty clay loam or silty clay. Some pedons have a C horizon, which has colors and textures similar to those of the Bt horizon.

Sarpy Series

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

Sarpy soils are adjacent to Haynie and Leta soils. Haynie soils are silty or loamy. They are slightly lower on the landscape than the Sarpy soils. Leta soils are clayey in the upper part and loamy in the lower part. They are lower on the landscape than the Sarpy soils.

Typical pedon of Sarpy loamy fine sand, 990 feet south and 1,450 feet west of the northeast corner of sec. 19, T. 51 N., R. 26 W., Ray County:

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; common fine roots; neutral; abrupt smooth boundary.

C—6 to 60 inches; grayish brown (10YR 5/2) fine sand; single grain; loose; few fine roots in the upper part; strongly effervescent; mildly alkaline.

The thickness of the solum is the same as that of the A1 or Ap horizon. Reaction ranges from neutral to moderately alkaline throughout the profile. Most pedons have free carbonates throughout the control section.

The A horizon has hue of 10YR, value of 3 to 5, and chroma of 1 to 3. It typically is loamy fine sand, but the range includes fine sand and fine sandy loam. The C horizon has hue of 10YR, value of 4 to 6, and chroma of 2 to 4. It is dominantly fine sand, but the range includes sand, loamy sand, and loamy fine 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 2 to 14 percent.

Sharpsburg soils commonly are adjacent to Armster, Lagonda, and Macksburg soils. The adjacent soils are on side slopes below the Sharpsburg soils. Armster soils have glacial sand and pebbles. Lagonda and Macksburg soils have a matrix with chroma of 2 in the upper part of the B horizon.

Typical pedon of Sharpsburg silt loam, 2 to 5 percent slopes, 2,300 feet east and 1,370 feet south of the northwest corner of sec. 20, T. 52 N., R. 27 W., Ray County:

A1—0 to 11 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; many fine roots; common fine pores and old root channels; slightly acid; clear smooth boundary.

A2—11 to 17 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; friable; many fine roots; many fine pores; slightly acid; clear smooth boundary.

Bt1—17 to 24 inches; dark brown (10YR 4/3) silty clay loam; moderate very fine subangular blocky structure; friable; many fine roots; common fine pores and old root channels; few distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; medium acid; clear smooth boundary.

Bt2—24 to 35 inches; dark yellowish brown (10YR 4/4) silty clay loam; many medium distinct light brownish gray (10YR 6/2) mottles; moderate fine and medium subangular blocky structure; firm; common fine roots; common fine root channels; common distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; few fine black stains and concretions of iron and manganese oxides; strongly acid; gradual smooth boundary.

Bt3—35 to 47 inches; yellowish brown (10YR 5/4) silty clay loam; many medium distinct dark grayish brown (10YR 4/2) and light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; firm; common fine roots; common fine root channels; common faint dark brown (10YR 4/3) clay films on faces of peds; common medium black stains; strongly acid; gradual smooth boundary.

Bt4—47 to 55 inches; mottled dark yellowish brown (10YR 4/4) and light brownish gray (10YR 6/2) silty clay loam; weak medium subangular blocky structure; friable; few fine roots; common fine root channels; few distinct dark grayish brown (10YR 4/2) clay films on faces of peds; common medium black stains; strongly acid; clear smooth boundary.

C—55 to 60 inches; mottled grayish brown (10YR 5/2) and dark yellowish brown (10YR 4/4) silt loam; massive; friable; few fine roots; medium acid.

The thickness of the solum ranges from 36 to 72 inches. The mollic epipedon ranges from 10 to 24 inches in thickness.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. It typically is silt loam, but the range includes silty clay loam. The Bt horizon has hue of 10YR, value of 4, and chroma of 3 or 4. The lower part of the Bt horizon has mottles with hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 6. The Bt horizon is medium acid or strongly acid. The content of clay in this horizon ranges from 36 to 42 percent. The C horizon has mottles with hue of 10YR to 5Y, value of 4 to 6, and chroma of 2 to 6. It typically is silt loam but in some pedons is silty clay loam.

Sharpsburg silt loam, 5 to 9 percent slopes, eroded, and Sharpsburg silt loam, 9 to 14 percent slopes, eroded, have a lighter colored or thinner surface layer than is definitive for the series. This difference, however, does not significantly affect the use or management of the soils.

Sibley Series

The Sibley series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in silty loess. Slopes range from 2 to 9 percent.

Sibley soils are similar to Wiota soils and commonly are adjacent to Higginsville, Knox, and Sharpsburg soils. Higginsville soils have mottles with chroma of 2 in the upper part of the B horizon. They are on side slopes below the Sibley soils. Knox soils do not have a mollic epipedon. They are on the steeper side slopes. Sharpsburg soils have a mollic epipedon that is less than 24 inches thick and contain more clay in the B horizon than the Sibley soils. Also, they are farther from the flood plains along the Missouri River. Wiota soils contain more sand than the Sibley soils. They are on stream terraces.

Typical pedon of Sibley silt loam, 2 to 5 percent slopes, 460 feet north and 1,400 feet east of the southwest corner of sec. 11, T. 51 N., R. 31 W., Clay County:

A—0 to 11 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak very fine granular structure; friable; many fine roots; neutral; clear smooth boundary.

BA—11 to 18 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine angular blocky structure; friable; many fine roots; neutral; clear smooth boundary.

Bt1—18 to 25 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark brown (10YR 3/3) crushed, dark brown (10YR 4/3) dry; moderate fine subangular blocky structure; firm; common fine roots; common faint clay films on faces of peds; neutral; clear smooth boundary.

Bt2—25 to 38 inches; dark brown (10YR 4/3) silty clay loam; moderate fine subangular blocky structure; firm; few fine roots; common faint clay films on faces of peds; slightly acid; clear smooth boundary.

Bt3—38 to 49 inches; dark yellowish brown (10YR 4/4) and grayish brown (10YR 5/2) silty clay loam; few fine prominent strong brown (7.5YR 5/6 to 5/8) mottles; weak medium subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; medium acid; gradual smooth boundary.

C—49 to 72 inches; mottled dark yellowish brown (10YR 4/4), grayish brown (10YR 5/2), and strong brown (7.5YR 5/6 to 5/8) silt loam; massive; friable; medium acid.

The solum is 46 to more than 60 inches thick. The mollic epipedon is 24 to 36 inches thick. Reaction generally is medium acid to neutral throughout the profile, but in some pedons it ranges to mildly alkaline in the upper part of the mollic epipedon.

The A horizon has hue of 10YR and value and chroma of 2 or 3. It commonly is silt loam in the upper part and silt loam or silty clay loam in the lower part. The B horizon has hue of 10YR. It has value of 3 and chroma of 2 or 3 in the upper part and value of 3 to 5 and chroma of 3 or 4 in the lower part. It does not have mottles or matrix colors with chroma of 2 or less within 36 inches of the surface. The content of clay in this horizon is 32 to 35 percent. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It has mottles with hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 6. It commonly is silt loam, but in some pedons it is silty clay loam.

Snead Series

The Snead series consists of moderately deep, moderately well drained, slowly permeable soils on uplands. These soils formed in material weathered from calcareous, clayey shale and thin layers of interbedded limestone. Slopes range from 5 to 30 percent.

Snead soils commonly are adjacent to the deep Armster, Greenton, Ladoga, and Sampsel soils. Armster and Ladoga soils are on side slopes and ridgetops above the Snead soils. Greenton soils and the poorly drained Sampsel soils are on side slopes and foot slopes below the Snead soils.

Typical pedon of Snead flaggy silty clay loam, in an area of Snead-Rock outcrop complex, 14 to 30 percent slopes, 462 feet south and 1,550 feet east of the northwest corner of sec. 3, T. 53 N., R. 27 W., Ray County:

A1—0 to 4 inches; very dark brown (10YR 2/2) flaggy silty clay loam, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; friable; many fine and medium roots; about 20 percent flat limestone fragments 1 to 15 inches long; neutral; clear smooth boundary.

A2—4 to 12 inches; very dark brown (10YR 2/2) flaggy silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine and very fine subangular blocky structure; firm; few large roots; about 20 percent flat limestone fragments 1 to 15 inches long; neutral; clear smooth boundary.

A3—12 to 19 inches; very dark grayish brown (10YR 3/2) flaggy silty clay, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; firm; many fine and medium roots; about 20 percent flat limestone fragments 1 to 15 inches long; neutral; clear smooth boundary.

Bw—19 to 26 inches; dark grayish brown (10YR 4/2) silty clay; common fine faint grayish brown (10YR 5/2) and brown (10YR 4/3) mottles; moderate fine subangular blocky structure; very firm; common fine roots; slightly effervescent; neutral; clear smooth boundary.

C—26 to 38 inches; dark grayish brown (2.5Y 4/2), grayish brown (2.5Y 5/2), and olive brown (2.5Y 4/4) silty clay; massive; very firm; few fine roots; few weathered shale fragments; strongly effervescent; mildly alkaline; clear smooth boundary.

Cr—38 to 60 inches; dark gray (5Y 4/1) weathered shale; few fine dark grayish brown (2.5Y 4/2) and olive brown (2.5Y 4/4) mottles; slightly effervescent; mildly alkaline.

Thickness of the solum ranges from 15 to 30 inches. The depth to bedrock ranges from 20 to 40 inches. The depth to free carbonates ranges from 12 to 20 inches.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is slightly acid or neutral. The content of flat limestone fragments in this horizon ranges from 20 to 25 percent. The B horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 2 to 6 and is mottled. It is silty clay or clay and is neutral to moderately alkaline. The C horizon has the same range in color and texture as the B horizon.

Wabash Series

The Wabash series consists of deep, very poorly drained, very slowly permeable soils on flood plains along tributaries of the Missouri River. These soils formed in clayey alluvium. Slopes range from 0 to 2 percent.

Wabash soils are similar to Booker and Zook soils and commonly are adjacent to Colo, Nodaway, and Zook soils. Booker soils contain more clay in the control section than the Wabash soils. Colo, Nodaway, and Zook soils contain less clay in the control section than the Wabash soils, and Nodaway soils are browner. Also, Colo and Nodaway soils are closer to the stream channels.

Typical pedon of Wabash silty clay, 3,960 feet north and 30 feet east of the southwest corner of sec. 24, T. 54 N., R. 27 W., Ray County:

Ap—0 to 6 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate fine angular blocky structure parting to weak very fine granular; firm; many fine roots; medium acid; abrupt smooth boundary.

A—6 to 14 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure parting to moderate medium granular; very firm; many fine roots; medium acid; clear smooth boundary.

Bg1—14 to 20 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; very firm; many fine roots; slightly acid; clear smooth boundary.

Bg2—20 to 30 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; very firm; many fine roots; slightly acid; clear smooth boundary.

Bg3—30 to 41 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; very firm; few fine roots; neutral; gradual smooth boundary.

Bg4—41 to 56 inches; very dark gray (10YR 3/1) silty clay; moderate medium angular blocky structure; very firm; few fine roots; neutral; gradual smooth boundary.

Bg5—56 to 66 inches; very dark gray (10YR 3/1) silty clay loam; few fine distinct gray (10YR 5/1) and few fine distinct dark brown (10YR 4/3) mottles; weak fine subangular blocky structure; firm; neutral.

The thickness of the solum ranges from about 40 to more than 60 inches. The depth to free carbonates is more than 40 inches.

The A horizon has hue of 10YR or 5Y, value of 2 or 3, and chroma of 2 or less. The Ap horizon is dominantly silty clay but is silty clay loam in some pedons. It ranges from medium acid to neutral. The matrix colors in the part of the B horizon within a depth of 36 inches are the same as those in the A horizon. The part below a depth of 36 inches has the same range in hue and chroma but commonly has higher value, ranging to 4 or 5. The content of clay in the 10- to 40-inch control section ranges from 46 to 60 percent. The B horizon ranges from slightly acid to mildly alkaline. The C horizon is similar in color, texture, and reaction to the B horizon.

Waldron Series

The Waldron series consists of deep, somewhat poorly drained, slowly permeable soils on the flood plains along the Missouri River. These soils formed in calcareous, stratified deposits of clayey and loamy alluvium. Slopes range from 0 to 2 percent.

Waldron soils commonly are adjacent to Haynie, Leta, and Levasy soils. They are slightly lower on the landscape than the adjacent soils. Haynie soils are silty or loamy. Leta and Levasy soils are clayey in the upper part and loamy in the lower part.

Typical pedon of Waldron silty clay loam, 1,400 feet south and 800 feet east of the northwest corner of sec. 24, T. 51 N., R. 31 W., Clay County:

Ap—0 to 5 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium granular structure; firm; few fine roots; slightly effervescent; mildly alkaline; abrupt smooth boundary.

A—5 to 9 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure parting to weak fine granular; firm; few fine roots; a 1-inch stratum of very dark grayish brown (10YR 3/2) clay that has strong medium angular blocky structure; slightly effervescent; mildly alkaline; clear smooth boundary.

C1—9 to 15 inches; very dark grayish brown (10YR 4/2) silty clay, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; very firm; few fine roots; a 1-inch stratum of very dark grayish brown (10YR 3/2) clay; slightly effervescent; mildly alkaline; clear smooth boundary.

C2—15 to 31 inches; stratified, dark grayish brown (10YR 4/2) silty clay; few fine prominent dark brown (7.5YR 4/4) mottles; moderate medium subangular blocky structure; very firm; few fine roots; a thin lense of grayish brown (10YR 5/2) very fine sandy loam; thin layers of grayish brown (10YR 5/2) silt between clay layers; strongly effervescent; moderately alkaline; abrupt smooth boundary.

C3—31 to 38 inches; very dark grayish brown (10YR 3/2) silty clay; weak fine subangular blocky structure; very firm; few fine roots; slightly effervescent; moderately alkaline; abrupt smooth boundary.

C4—38 to 45 inches; dark grayish brown (2.5Y 4/2) silty clay; few fine prominent dark brown (7.5YR 4/4) mottles; moderate fine subangular blocky structure; very firm; very few very fine roots; slightly effervescent; mildly alkaline; abrupt smooth boundary.

C5—45 to 60 inches; dark grayish brown (2.5Y 4/2) silty clay; common fine distinct dark brown (10YR 4/3) mottles; weak medium angular blocky structure; very firm; very few very fine roots; strongly effervescent; mildly alkaline.

Free carbonates and slight effervescence are within 10 inches of the surface. Reaction ranges from neutral to moderately alkaline throughout the profile.

The Ap or A1 horizon has hue of 10YR to 5Y, value of 2 or 3, and chroma of 1 to 3. It typically is silty clay loam, but the range includes silty clay. The C horizon has hue of 10YR or 2.5Y, value of 2 to 5, and chroma of 1 to 4. It has mottles with higher chroma or redder hue. The content of clay in the 10- to 40-inch control section ranges from 35 to 50 percent. Thin lenses of coarser textures are in the control section.

Wiota Series

The Wiota series consists of deep, well drained, moderately permeable soils on stream terraces. These soils formed in silty alluvium that washed in from loess-covered uplands. Slopes range from 0 to 2 percent.

Wiota soils are similar to Cotter soils and commonly are adjacent to Bremer, Snead, and Zook soils. Bremer and Zook soils are poorly drained and are lower on the landscape than the Wiota soils. Cotter soils contain less clay in the lower part of the solum than the Wiota soils. Snead soils are moderately deep. They are on uplands.

Typical pedon of Wiota silt loam, 1,600 feet north and 330 feet east of the southwest corner of sec. 17, T. 51 N., R. 32 W., Clay County:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; common fine roots; medium acid; abrupt smooth boundary.

A—7 to 12 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; common fine roots; medium acid; clear smooth boundary.

BA—12 to 22 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; friable; common fine roots; very dark grayish brown (10YR 3/2) organic coatings on faces of peds; slightly acid; clear smooth boundary.

Bt1—22 to 33 inches; brown (10YR 4/3) silty clay loam; moderate fine subangular blocky structure; friable; few fine roots; common faint very dark grayish brown (10YR 3/2) clay films on faces of peds and along root channels; slightly acid; gradual smooth boundary.

Bt2—33 to 49 inches; brown (10YR 4/3) silty clay loam; moderate medium subangular blocky structure; friable; few faint dark grayish brown (10YR 4/2) clay films on faces of peds; very dark grayish brown (10YR 3/2) root channels; medium acid; gradual smooth boundary.

C—49 to 60 inches; brown (10YR 4/3) silty clay loam; few medium distinct grayish brown (10YR 5/2) mottles; massive; some vertical cleavage; very dark grayish brown (10YR 3/2) root channels; medium acid.

The solum ranges from 36 to 60 inches in thickness. It is slightly acid to strongly acid. The mollic epipedon ranges from about 18 to 32 inches in thickness and includes the upper part of the B horizon in most pedons.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is silt loam or silty clay loam. The upper part of the Bt horizon is dark brown (10YR 3/3), and the lower part has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. The content of clay in this horizon is 32 to 36 percent. The C horizon has matrix colors similar to those of the Bt horizon, but in some pedons it has mottles with both low and high chroma.

Zook Series

The Zook series consists of deep, poorly drained, slowly permeable soils on moderately wide flood plains. These soils formed in silty and clayey alluvium. Slopes range from 0 to 2 percent.

Zook soils are similar to Colo and Wabash soils and commonly are adjacent to Bremer, Nodaway, and Wabash soils. Bremer soils have a mollic epipedon that is less than 36 inches thick and have an argillic horizon. They are on stream terraces. Colo soils contain less clay than the Zook soils. Nodaway soils also contain less clay, are browner, and are closer to the stream channels. Wabash soils contain more clay than the Zook soils.

Typical pedon of Zook silty clay loam, 1,350 feet west and 30 feet north of the southeast corner of sec. 1, T. 54 N., R. 27 W., Ray County:

Ap—0 to 6 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine and medium granular structure; firm; many fine roots; slightly acid; abrupt smooth boundary.

A1—6 to 17 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; firm; many fine roots; slightly acid; gradual smooth boundary.

A2—17 to 26 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure parting to weak fine subangular blocky; firm; common fine roots; slightly acid; gradual smooth boundary.

AB—26 to 37 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; moderate medium subangular blocky structure; firm; few fine roots; slightly acid; clear smooth boundary.

Bg—37 to 50 inches; dark gray (10YR 4/1) silty clay loam; moderate coarse subangular blocky structure; firm; few fine roots; neutral; clear smooth boundary.

Cg—50 to 66 inches; mottled dark gray (10YR 4/1) and dark grayish brown (2.5Y 4/2) silty clay loam; massive; some vertical cleavage; firm; few fine roots in the upper part; neutral.

The solum ranges from 36 to 60 inches in thickness. Reaction ranges from medium acid to neutral throughout the profile. The content of clay in the solum ranges from 32 to 45 percent. The mollic epipedon is more than 36 inches thick.

The A horizon is black (10YR 2/1) in the upper part and black (10YR 2/1) or very dark gray (10YR 3/1) in the lower part. It is silty clay loam or silty clay. The B and C horizons also are silty clay loam or silty clay. They have hue of 10YR or 5Y, value of 2 to 5, and chroma of 1. Mottles with higher chroma are below a depth of 36 inches.

Factors of Soil Formation

Soil forms through processes that act on accumulated or deposited geologic material. The characteristics of the soil are determined by the type of parent material; the plant and animal life on and in the soil; the climate under which the soil-forming factors have been active; the topography, or lay of the land; and the length of time that these factors have been active.

The parent material affects the kind of soil profile that forms and, in a few areas, determines it almost entirely. Plant and animal life, chiefly plants, are active factors of soil formation. The climate determines the amount of water available for leaching and the amount of heat for physical and chemical changes. Climate and plant and animal life act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. Relief commonly modifies the effects of the other factors. Finally, time is needed for the changes that transform the parent material into a soil. Generally, a long time is needed for the development of distinct soil horizons.

These factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made about the effect of any one factor unless conditions are specified about the other four.

Parent Material

Parent material is the unconsolidated mass in which a soil forms. The formation or deposition of this material is the first step in the development of a soil profile. The characteristics of the parent material determine the chemical and mineralogical composition of the soil. Four kinds of parent material, alone or in combination, have contributed to the formation of the soils in Clay and Ray Counties. These are material weathered from bedrock; glacial material; loess, or wind-deposited material; and alluvium, or water-deposited material.

Greenton, Sampsel, and Snead soils formed in material weathered from shale interbedded with thin layers of limestone. Greenton soils also formed in a thin layer of loess overlying the residual material.

Glacial parent material, which consists of clay, silt, sand, gravel, and a few boulders, was transported during periods of glaciation. Much of the glacial material was moved long distances, but some of it is of local origin. Armster and Lagonda soils formed in loess or pedisediments and in the underlying glacial till.

Loess, or silty material transported by wind, is an extensive parent material in Clay and Ray Counties. The principal source of the loess was probably the flood plains along the Missouri River after the retreat of the last glacier. The thickest deposits are on the hills bordering these flood plains. Knox and Sibley soils formed in the loess on these uplands (fig. 12). Farther from the source, the deposits are thinner and contain more clay. The finer textured parent material and gentler slopes resulted in soils that are more poorly drained. Grundy, Ladoga, and Sharpsburg soils are examples.

Alluvium is material that was transported by water and deposited on nearly level flood plains. Depending on the diverse origins and varying speeds of the flowing water, this material varies greatly in texture and mineralogical composition. The source of the alluvium on the flood plains along small tributary streams is limited to local uplands. The coarser textured Nodaway soils formed in alluvium deposited in areas near the stream channels where the current was strongest. The finer textured Wabash and Zook soils formed in alluvium in areas away from the stream channels where the finer clay particles settled from the backwater. The vast drainage area of the Missouri River is the source of the parent material of the soils on the flood plains along the river. These soils have a wider range of texture than the soils along the small tributaries. The coarser textured Haynie, Landes, and Sarpy soils formed in alluvium deposited while the water was flowing rapidly enough to carry sand-size particles. The finer textured Aholt, Booker, Leta, Levasy, and Waldron soils formed in alluvium deposited in slack water areas.

Plant and Animal Life

Plant and animal life on or in the soil is an active soil-forming factor. Plants furnish organic matter to the soil and bring plant nutrients from underlying layers to the surface layer. As plants die and decay, they contribute organic matter to the soil. Bacteria and fungi decompose the plant remains and help incorporate the organic matter into the soil.

The kind of native vegetation has greatly influenced soil formation in the two counties. The addition of organic matter to the soils that formed under prairie grasses is largely the result of the yearly decomposition of plant material. The plant tops decompose at the surface, but a

Figure 12.—Profile of Knox soils, which formed in a thick layer of loess.

large share of this material consists of roots, which decompose at various depths in the soil. Soils that formed under prairie grasses have a thick, dark surface layer. Higginsville, Sharpsburg, and Sibley soils are examples.

The addition of organic matter to the soils that formed under forest vegetation is mostly the result of the decomposition of leaves and twigs on the surface. These soils have a thin, dark surface layer. Armster, Knox, and Ladoga soils are examples.

Insects, worms, animals, and human activities affect the soils. The effect of bacteria and fungi, which cause the rotting of organic material, fix nitrogen, and improve tilth, is greater than the effect of animals. Burrowing animals and insects loosen and mix various soil horizons. Human activities can greatly affect soil formation in a short period. The major alterations in Clay and Ray Counties have resulted from changes in vegetation, drainage, and accelerated erosion. Row crops have replaced native grasses and many forested areas. Nearly all the flood plains and many of the uplands are now farmed. These changes have increased food production, but they have adversely affected sustained productivity. Accelerated erosion continues to reduce the potential of many upland soils. Also, the loss of cropland to urban development is virtually irreversible.

Climate

Climate continues to be an important factor of soil formation in the survey area. Geologic erosion, plant and animal life, and, in more recent times, accelerated erosion have varied with the climate. The present climatic conditions tend to favor forest vegetation rather than prairie grasses. The more arid climatic conditions of the past favored prairie grasses.

The glacial periods, which greatly affected soil-forming processes, were a result of climatic changes. Thousands of years of cold temperatures resulted in the glaciers that moved into the area. Warmer temperatures and high winds resulted in severe geologic erosion, and much of the area was covered by loess.

High temperatures and adequate rainfall encourage rapid chemical and physical changes. This type of climate is conducive to the breakdown of minerals and the relocation of clay within the soil. As the clay is moved downward, a subsoil forms. Nearly all the upland soils show the evidence of this eluviation.

Topography

Topography, or the lay of the land, affects soil formation through its effect on drainage, runoff, infiltration, and accelerated erosion. The length, shape, aspect, and gradient of slopes help to determine the pattern and distribution of soils.

The amount of water entering the soil depends on the slope, permeability, and the intensity of rainfall. Because runoff is rapid in steep areas, very little water passes through the soil and soil formation is slow. Geologic erosion almost keeps pace with the soil-forming processes. In gently sloping areas, runoff is slow and erosion is minimal. Most of the water passes through the soil. As a result, leaching, the translocation of clay, and other soil-forming processes are intensified. The soils in these areas are characterized by maximum profile development.

Steep, south-facing slopes receive more direct sunrays and are more droughty than north-facing slopes. The droughtiness affects soil formation through its effect on the kind of vegetation, erosion, and freezing and thawing.

Time

The age of a soil is an indication of the degree of profile development rather than an indication of the number of years that the soil material has existed. The degree of profile development depends partly on the length of time that the parent material has been in place and has been subject to the soil-forming processes. The older soils show the effects of leaching and clay movement and have distinct horizons. Young soils show little evidence of profile development.

Alluvial soils are the youngest soils. Nodaway soils show no evidence of profile development because alluvial material is added nearly every year. Bremer and Moniteau soils, which are older alluvial soils on stream terraces, have distinct horizons.

The moderately sloping to steep, moderately deep Snead soils formed in shale and limestone residuum that is much older than the parent material of other soils. The removal of soil material through geological erosion, however, nearly keeps pace with the soil-forming processes. As a result, these soils are considered young.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

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.

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

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.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 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.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

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.

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.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

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 till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

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.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. 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.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—
Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.
Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.
Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.
Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.
Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.
Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.
Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Large stones (in tables). Rock fragments 3 inches (7.6 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.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedisediment. A thin layer of alluvial material that mantles an erosion surface and has been transported to its present position from higher lying areas of the erosion surface.

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.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor 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.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

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.

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.

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 multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes 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.

Stone line. A concentration of coarse fragments in a soil. Generally it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that inferfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. 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 grain* (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 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. Includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Data were recorded in the period 1951-79 at Kansas City, Mo.]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	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	Units	In	In	In		In
January----	37.8	19.8	28.8	69	-6	0	1.17	0.28	1.87	3	6.9
February---	43.5	25.1	34.3	73	-1	10	1.28	.57	1.88	4	4.1
March------	52.7	32.8	42.8	84	9	65	2.51	1.19	3.64	6	5.1
April------	66.6	45.7	56.2	89	26	217	3.34	1.94	4.58	7	.7
May--------	76.6	56.8	66.7	93	37	518	4.12	2.89	5.25	7	.0
June-------	85.0	66.3	75.7	99	50	771	5.18	2.77	7.30	8	.0
July-------	89.2	70.8	80.0	103	56	930	4.42	1.54	6.80	7	.0
August-----	88.5	69.2	78.9	103	55	896	3.69	1.37	5.62	6	.0
September--	81.2	60.7	71.0	98	42	630	4.08	1.17	6.42	6	.0
October----	70.3	49.5	59.9	91	30	333	3.02	.94	4.71	5	.0
November---	54.8	35.9	45.4	78	14	46	1.56	.26	2.54	3	.9
December---	42.8	26.2	34.5	68	0	12	1.38	.48	2.12	4	4.5
Yearly:											
Average--	65.8	46.6	56.2	---	---	---	---	---	---	---	---
Extreme--	---	---	---	104	-6	---	---	---	---	---	---
Total----	---	---	---	---	---	4,428	35.75	27.58	44.29	66	22.2

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Data were recorded in the period 1951-79 at Kansas City, Mo.]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 14	April 28	May 8
2 years in 10 later than--	April 3	April 17	April 25
5 years in 10 later than--	March 13	March 25	April 2
First freezing temperature in fall:			
1 year in 10 earlier than--	October 31	October 26	October 16
2 years in 10 earlier than--	November 6	October 30	October 21
5 years in 10 earlier than--	November 18	November 6	October 31

TABLE 3.--GROWING SEASON

[Data were recorded in the period 1951-79 at Kansas City, Mo.]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	220	201	185
8 years in 10	228	207	192
5 years in 10	244	220	206
2 years in 10	260	232	220
1 year in 10	268	239	227

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Clay County	Ray County	Total-- Area	Total-- Extent
		Acres	Acres	Acres	Pct
1B	Sibley silt loam, 2 to 5 percent slopes	2,250	2,450	4,700	0.8
1C	Sibley silt loam, 5 to 9 percent slopes	1,625	2,950	4,575	0.7
2C	Higginsville silt loam, 5 to 9 percent slopes	590	2,850	3,440	0.6
5C	Macksburg silt loam, 5 to 9 percent slopes	19,300	2,350	21,650	3.5
6B	Sharpsburg silt loam, 2 to 5 percent slopes	24,100	11,000	35,100	5.7
6C2	Sharpsburg silt loam, 5 to 9 percent slopes, eroded	28,100	10,850	38,950	6.3
6D2	Sharpsburg silt loam, 9 to 14 percent slopes, eroded	5,750	3,350	9,100	1.5
8	Pits, quarries	400	390	790	0.1
9D	Snead silty clay loam, 5 to 14 percent slopes	1,950	8,700	10,650	1.7
9E	Snead silty clay loam, 14 to 30 percent slopes	235	988	1,223	0.2
10D	Snead-Rock outcrop complex, 5 to 14 percent slopes	6,100	8,500	14,600	2.4
10F	Snead-Rock outcrop complex, 14 to 30 percent slopes	6,500	28,700	35,200	5.7
11C2	Greenton silty clay loam, 5 to 9 percent slopes, eroded	2,400	9,400	11,800	1.9
11C3	Greenton silty clay loam, 5 to 9 percent slopes, severely eroded	190	2,150	2,340	0.4
11D3	Greenton silty clay loam, 9 to 14 percent slopes, severely eroded	1,440	6,650	8,090	1.3
13B	Sampsel silty clay loam, 2 to 5 percent slopes	10	2 750	2,760	0.4
13C	Sampsel silty clay loam, 5 to 9 percent slopes	280	4,050	4,330	0.7
24B	Lagonda silt loam, 2 to 5 percent slopes	100	7,850	7,950	1.3
25C2	Lagonda silty clay loam, 5 to 9 percent slopes, eroded	19,450	41,600	61,050	9.9
25D2	Lagonda silty clay loam, 9 to 14 percent slopes, eroded	560	1,950	2,510	0.4
26B	Ladoga silt loam, 2 to 5 percent slopes	3,400	3,850	7,250	1.2
26C2	Ladoga silt loam, 5 to 9 percent slopes, eroded	6,200	7,400	13,600	2.2
26D2	Ladoga silt loam, 9 to 14 percent slopes, eroded	5,600	1,950	7,550	1.2
27D3	Ladoga silty clay loam, 5 to 14 percent slopes, severely eroded	1,100	3,550	4,650	0.8
31	Colo silty clay loam	475	4,750	5,225	0.8
33	Zook silty clay loam	3,250	6,850	10,100	1.6
35	Booker silty clay	0	6,100	6,100	1.0
36	Bremer silt loam	6,550	8,350	14,900	2.4
37	Moniteau silt loam	225	1,850	2,075	0.3
38	Wiota silt loam	3,900	1,400	5,300	0.9
39	Nodaway silt loam	15,900	20,300	36,200	5.9
41C2	Armster loam, 5 to 9 percent slopes, eroded	10,800	17,650	28,450	4.6
41D2	Armster loam, 9 to 14 percent slopes, eroded	9,250	7,150	16,400	2.7
42C3	Armster clay loam, 5 to 9 percent slopes, severely eroded	400	2,950	3,350	0.5
42E3	Armster clay loam, 9 to 20 percent slopes, severely eroded	460	3,150	3,610	0.6
54C2	Knox silt loam, 5 to 9 percent slopes, eroded	3,650	5,200	8,850	1.4
54E2	Knox silt loam, 14 to 20 percent slopes, eroded	4,450	3,750	8,200	1.3
54F	Knox silt loam, 20 to 30 percent slopes	2,800	3,450	6,250	1.0
55D3	Knox silty clay loam, 5 to 14 percent slopes, severely eroded	7,600	7,300	14,900	2.4
56B	Grundy silt loam, 2 to 5 percent slopes	1,790	10,300	12,090	2.0
57C2	Grundy silty clay loam, 5 to 9 percent slopes, eroded	2,300	4,400	6,700	1.1
61C	Knox-Urban land complex, 5 to 9 percent slopes	3,100	0	3,100	0.5
61D	Knox-Urban land complex, 9 to 14 percent slopes	3,000	0	3,000	0.5
61E	Knox-Urban land complex, 14 to 20 percent slopes	690	0	690	0.1
68C	Urban land, upland, 5 to 9 percent slopes	570	0	570	0.1
69A	Urban land, bottom land, 0 to 3 percent slopes	2,600	0	2,600	0.4
70B	Sharpsburg-Urban land complex, 2 to 5 percent slopes	2,500	0	2,500	0.4
70C	Sharpsburg-Urban land complex, 5 to 9 percent slopes	5,050	0	5,050	0.8
70D	Sharpsburg-Urban land complex, 9 to 14 percent slopes	1,750	0	1,750	0.3
71	Aholt clay	0	2,950	2,950	0.5
72	Dockery silt loam	240	2,750	2,990	0.5
73	Leta silty clay	4,800	12,600	17,400	2.8
74	Levasy silty clay	0	5,700	5,700	0.9
75	Norborne very fine sandy loam	0	3,200	3,200	0.5
78	Myrick silty clay loam	0	870	870	0.1
80	Landes fine sandy loam	95	3,550	3,645	0.6
81	Waldron silty clay loam	1,020	9,570	10,590	1.7
82	Parkville silty clay	3,200	3,380	6,580	1.1
83	Haynie silt loam	7,700	5,250	12,950	2.1
87	Modale silt loam	1,675	4,200	5,875	1.0
88	Gilliam silt loam	2,850	2,600	5,450	0.9
89	Sarpy loamy fine sand	66	547	613	0.1
90	Wabash silty clay	650	9,300	9,950	1.6
92	Cotter silt loam	810	6,200	7,010	1.1
	Total land area	253,796	363,795	617,591	100.0
	Water areas more than 40 acres	7,695	3,379	11,074	
	Total area	261,491	367,174	628,665	

TABLE 5.--PRIME FARMLAND

[Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name]

Map symbol	Soil name
1B	Sibley silt loam, 2 to 5 percent slopes
1C	Sibley silt loam, 5 to 9 percent slopes
6B	Sharpsburg silt loam, 2 to 5 percent slopes
13B	Sampsel silty clay loam, 2 to 5 percent slopes (where drained)
24B	Lagonda silt loam, 2 to 5 percent slopes
26B	Ladoga silt loam, 2 to 5 percent slopes
31	Colo silty clay loam (where drained)
33	Zook silty clay loam (where drained)
35	Booker silty clay (where drained)
36	Bremer silt loam (where drained)
37	Moniteau silt loam (where drained)
38	Wiota silt loam
39	Nodaway silt loam
56B	Grundy silt loam, 2 to 5 percent slopes
71	Aholt clay (where drained)
72	Dockery silt loam
73	Leta silty clay
74	Levasy silty clay (where drained)
75	Norborne very fine sandy loam
80	Landes fine sandy loam
81	Waldron silty clay loam (where drained)
82	Parkville silty clay
83	Haynie silt loam
87	Modale silt loam
88	Gilliam silt loam
90	Wabash silty clay (where drained)
92	Cotter silt loam

TABLE 6.--LAND CAPABILITY 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	Corn	Soybeans	Winter wheat	Grain sorghum	Grass-legume hay	Smooth bromegrass	Tall fescue
		Bu	Bu	Bu	Bu	Tons	AUM*	AUM*
1B-------------- Sibley	IIe	115	45	48	95	5.0	10.0	8.0
1C-------------- Sibley	IIIe	108	39	40	85	4.8	9.6	7.8
2C-------------- Higginsville	IIIe	108	41	45	94	4.8	9.6	7.8
5C-------------- Macksburg	IIIe	103	39	43	90	4.6	9.3	7.7
6B-------------- Sharpsburg	IIe	102	43	45	88	5.0	9.0	7.5
6C2------------- Sharpsburg	IIIe	90	40	42	80	4.8	8.8	7.2
6D2------------- Sharpsburg	IIIe	82	30	34	70	3.7	7.4	6.6
8**. Pits								
9D-------------- Snead	IVe	55	21	25	50	2.7	4.0	4.8
9E-------------- Snead	VIe	---	---	---	---	2.1	3.6	4.2
10D------------- Snead-Rock outcrop	VIs	---	---	---	---	2.1	2.5	3.8
10F------------- Snead-Rock outcrop	VIIs	---	---	---	---	---	2.5	3.8
11C2------------ Greenton	IIIe	77	28	31	65	3.4	6.8	6.0
11C3------------ Greenton	IVe	---	---	26	---	3.0	4.5	5.0
11D3------------ Greenton	VIe	---	---	---	---	2.7	4.0	4.6
13B------------- Sampsel	IIe	86	33	35	74	3.7	7.6	6.8
13C------------- Sampsel	IIIe	79	30	30	66	3.5	7.0	6.5
24B------------- Lagonda	IIe	90	34	38	83	3.3	8.4	7.3
25C2------------ Lagonda	IIIe	76	28	34	65	2.9	6.6	6.2
25D2------------ Lagonda	VIe	---	---	---	---	2.1	4.6	4.4

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Winter wheat	Grain sorghum	Grass-legume hay	Smooth bromegrass	Tall fescue
		Bu	Bu	Bu	Bu	Tons	AUM*	AUM*
26B------------- Ladoga	IIe	92	35	39	76	4.1	8.2	5.8
26C2------------ Ladoga	IIIe	80	30	33	68	3.8	7.2	5.7
26D2------------ Ladoga	IIIe	70	26	28	58	3.2	7.2	6.8
27D3------------ Ladoga	IVe	62	23	25	54	3.0	5.5	6.2
31-------------- Colo	IIw	98	40	---	100	4.5	---	8.5
33-------------- Zook	IIw	85	36	---	83	4.0	---	8.0
35-------------- Booker	IIIw	60	25	28	60	2.7	---	5.5
36-------------- Bremer	IIw	96	36	42	83	4.0	---	8.0
37-------------- Moniteau	IIIw	84	31	35	72	4.2	4.0	5.5
38-------------- Wiota	I	110	42	46	98	4.6	9.6	7.8
39-------------- Nodaway	IIw	80	30	---	70	3.7	7.4	7.0
41C2------------ Armster	IIIe	58	25	28	55	2.7	5.2	5.4
41D2------------ Armster	IVe	50	22	25	45	2.3	4.6	5.2
42C3------------ Armster	IVe	52	18	22	50	2.5	4.2	5.0
42E3------------ Armster	VIe	---	---	---	---	2.4	4.0	4.8
54C2------------ Knox	IIIe	89	33	34	80	3.7	8.0	6.6
54E2------------ Knox	IVe	---	---	---	---	2.8	6.5	5.8
54F------------- Knox	VIe	---	---	---	---	---	6.0	5.8
55D3------------ Knox	IVe	65	24	26	---	3.0	6.4	6.0
56B------------- Grundy	IIe	98	38	40	85	4.4	8.8	7.5
57C2------------ Grundy	IIIe	80	30	34	68	3.6	7.2	6.0
61C------------- Knox-Urban land	---	---	---	---	---	---	---	---

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Winter wheat	Grain sorghum	Grass-legume hay	Smooth bromegrass	Tall fescue
		Bu	Bu	Bu	Bu	Tons	AUM*	AUM*
61D------------- Knox-Urban land	---	---	---	---	---	---	---	---
61E------------- Knox-Urban land	---	---	---	---	---	---	---	---
68C**, 69A**. Urban land								
70B------------- Sharpsburg-Urban land	---	---	---	---	---	---	---	---
70C------------- Sharpsburg-Urban land	---	---	---	---	---	---	---	---
70D------------- Sharpsburg-Urban land	---	---	---	---	---	---	---	---
71-------------- Aholt	IIIw	60	25	78	60	2.7	---	5.5
72-------------- Dockery	IIw	100	37	42	85	4.4	7.4	6.8
73-------------- Leta	IIw	88	32	35	75	3.8	7.4	7.0
74-------------- Levasy	IIIw	78	30	30	65	3.5	---	6.0
75-------------- Norborne	I	108	41	45	94	4.8	9.6	7.8
78-------------- Myrick	Vw	---	---	---	---	---	---	---
80-------------- Landes	IIIs	69	24	32	65	2.6	4.6	5.4
81-------------- Waldron	IIw	80	30	33	68	3.6	7.0	8.0
82-------------- Parkville	IIw	96	38	42	88	4.0	7.6	8.0
83-------------- Haynie	IIw	96	36	40	88	3.6	8.6	7.4
87-------------- Modale	I	92	35	35	85	3.9	8.0	7.2
88-------------- Gilliam	IIw	115	45	45	108	4.5	10.0	8.5
89-------------- Sarpy	IVs	---	---	15	---	0.9	1.8	2.5
90-------------- Wabash	IIIw	65	32	30	65	3.2	---	5.8
92-------------- Cotter	I	110	45	45	96	4.6	9.6	8.2

* 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 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: Erosion hazard	Equipment limitation	Windthrow hazard	Plant competition	Potential productivity: Common trees	Site index	Trees to plant
9D----------------- Snead	4c	Slight	Slight	Severe	Slight	Northern red oak---- White oak----------- White ash----------- Sugar maple---------	62 55 56 ---	Northern red oak, eastern redcedar, white ash.
9E----------------- Snead	4r	Moderate	Moderate	Severe	Slight	Northern red oak---- White oak----------- White ash----------- Sugar maple---------	62 55 56 ---	Northern red oak, eastern redcedar, white ash.
10D*: Snead--------------	4x	Slight	Moderate	Severe	Slight	Northern red oak---- White oak----------- White ash----------- Sugar maple---------	62 55 56 ---	Northern red oak, eastern redcedar, white ash.
Rock outcrop.								
10F*: Snead--------------	4r	Moderate	Severe	Severe	Slight	Northern red oak---- White oak----------- White ash----------- Sugar maple---------	62 55 56 ---	Northern red oak, eastern redcedar, white ash.
Rock outcrop.								
26B, 26C2, 26D2, 27D3-------------- Ladoga	3o	Slight	Slight	Slight	Moderate	White oak----------- Northern red oak----	65 65	Eastern white pine, white oak, sugar maple, northern red oak, black walnut.
35----------------- Booker	4w	Slight	Severe	Severe	Severe	Eastern cottonwood--	85	Eastern cottonwood, pin oak, pecan, green ash, silver maple.
36----------------- Bremer	3w	Slight	Severe	Moderate	Severe	Eastern cottonwood-- Silver maple--------	90 80	American sycamore, hackberry, green ash, eastern cottonwood, silver maple.
37----------------- Moniteau	4w	Slight	Severe	Moderate	Severe	Pin oak-------------	70	Pin oak, green ash, eastern cottonwood, silver maple.
39----------------- Nodaway	2o	Slight	Slight	Slight	Moderate	White oak----------- Black walnut--------	65 76	Black walnut, white oak, green ash.
41C2, 41D2, 42C3--- Armster	4o	Slight	Slight	Slight	Slight	Pin oak-------------	70	Pin oak, green ash, northern red oak, white oak, black oak.
42E3--------------- Armster	4r	Moderate	Moderate	Slight	Slight	Pin oak-------------	70	Pin oak, green ash, northern red oak, white oak, black oak.
54C2--------------- Knox	3o	Slight	Slight	Slight	Slight	Black oak----------- White oak----------- Northern red oak---- Black walnut--------	74 65 74 67	Eastern white pine, green ash, black walnut, yellow-poplar.

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Windthrow hazard	Plant competition	Potential productivity: Common trees	Site index	Trees to plant
54E2, 54F---------- Knox	3r	Moderate	Moderate	Slight	Slight	Black oak----------- White oak----------- Northern red oak---- Black walnut--------	74 65 74 67	Eastern white pine, green ash, black walnut, yellow-poplar.
55D3--------------- Knox	3o	Slight	Slight	Slight	Slight	Black oak----------- White oak----------- Northern red oak---- Black walnut--------	74 65 74 67	Eastern white pine, green ash, black walnut, yellow-poplar.
71----------------- Aholt	3w	Slight	Moderate	Severe	Severe	Eastern cottonwood-- Pin oak-------------	90 80	Pin oak, green ash, eastern cottonwood.
72----------------- Dockery	3o	Slight	Slight	Slight	Slight	Pin oak-------------	76	Pin oak, pecan, eastern cottonwood.
73----------------- Leta	3c	Slight	Moderate	Severe	Slight	Eastern cottonwood-- Black willow-------- Pin oak-------------	90 --- 76	Pecan, eastern cottonwood, silver maple, green ash.
74----------------- Levasy	3w	Slight	Severe	Severe	Severe	Eastern cottonwood-- Black willow--------	90 ---	Eastern cottonwood, pecan.
75----------------- Norborne	2o	Slight	Slight	Slight	Slight	Pin oak------------- Pecan---------------	90 75	Pin oak, pecan, green ash, yellow-poplar, eastern cottonwood.
78----------------- Myrick	3w	Slight	Severe	Moderate	Severe	Eastern cottonwood-- Pin oak-------------	85 75	Pin oak, eastern cottonwood.
80----------------- Landes	1o	Slight	Slight	Slight	Moderate	Eastern cottonwood-- Yellow-poplar------- American sycamore--- Sweetgum------------ Green ash-----------	105 95 --- --- ---	Eastern cottonwood, yellow-poplar, American sycamore, green ash, black walnut, eastern white pine.
81----------------- Waldron	2c	Slight	Moderate	Severe	Slight	Eastern cottonwood-- Pin oak-------------	110 80	Pecan, eastern cottonwood, black willow, green ash, silver maple, sweetgum.
82----------------- Parkville	2c	Slight	Moderate	Severe	Moderate	Eastern cottonwood--	100	Eastern cottonwood, pecan, sweetgum, American sycamore.
83----------------- Haynie	2o	Slight	Slight	Slight	Moderate	Eastern cottonwood-- American sycamore--- Black walnut-------- Green ash-----------	104 98 --- ---	Black walnut, eastern cottonwood, green ash, American sycamore.
88----------------- Gilliam	3o	Slight	Slight	Slight	Slight	Pin oak------------- Eastern cottonwood--	80 95	Pin oak, eastern cottonwood, pecan.
89----------------- Sarpy	3s	Slight	Slight	Slight	Slight	Eastern cottonwood-- Silver maple--------	95 90	Eastern cottonwood, American sycamore, silver maple.
90----------------- Wabash	4w	Slight	Severe	Moderate	Severe	Pin oak-------------	75	Pin oak, pecan, eastern cottonwood.
92----------------- Cotter	2o	Slight	Slight	Slight	Moderate	Eastern cottonwood-- Yellow-poplar-------	100 90	Eastern cottonwood, yellow-poplar, black walnut.

* 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 heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
1B, 1C------------ Sibley	---	Amur maple, Amur honeysuckle, lilac, autumn-olive.	Green ash, eastern redcedar, hackberry, bur oak, Russian-olive.	Eastern white pine, honeylocust, Austrian pine.	---
2C---------------- Higginsville	---	Amur honeysuckle, lilac, autumn-olive, Amur maple.	Eastern redcedar	Austrian pine, eastern white pine, honeylocust, hackberry, green ash, pin oak.	Eastern cottonwood.
5C---------------- Macksburg	Lilac-------------	Amur honeysuckle, autumn-olive, Manchurian crab-apple, Siberian peashrub.	Russian-olive, Austrian pine, eastern redcedar, jack pine, hack-berry, green ash.	Honeylocust-------	---
6B, 6C2, 6D2------ Sharpsburg	---	Amur maple, Amur honeysuckle, lilac, autumn-olive.	Green ash, hackberry, bur oak, eastern redcedar, Russian-olive.	Austrian pine, eastern white pine, honeylocust.	---
8*. Pits					
9D, 9E------------ Snead	Amur honeysuckle, fragrant sumac, lilac.	Autumn-olive------	Eastern redcedar, green ash, hack-berry, Austrian pine, Russian-olive, bur oak.	Honeylocust, Siberian elm.	---
10D*, 10F*:					
Snead------------	Amur honeysuckle, fragrant sumac, lilac.	Autumn-olive------	Eastern redcedar, green ash, hack-berry, Austrian pine, Russian-olive, bur oak.	Honeylocust, Siberian elm.	---
Rock outcrop.					
11C2, 11C3, 11D3-- Greenton	Lilac-------------	Amur honeysuckle, autumn-olive, Manchurian crabapple, Siberian peashrub.	Eastern redcedar, Austrian pine, hackberry, green ash, jack pine, Russian-olive.	Honeylocust-------	---
13B, 13C---------- Sampsel	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Norway spruce, honeylocust, green ash, golden willow, northern red oak.	Eastern cottonwood.
24B, 25C2, 25D2--- Lagonda	Lilac-------------	Manchurian crabapple, Amur honeysuckle, Siberian peashrub, autumn-olive.	Eastern redcedar, Austrian pine, hackberry, green ash, jack pine, Russian-olive.	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 heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
26B, 26C2, 26D2, 27D3------------- Ladoga	---	Lilac, Amur honeysuckle, autumn-olive, Amur maple.	Eastern redcedar, hackberry, green ash, bur oak, Russian-olive.	Austrian pine, eastern white pine, honeylocust.	---
31---------------- Colo	Redosier dogwood	American plum, common choke-cherry.	Eastern redcedar, hackberry.	Austrian pine, green ash, golden willow, honey-locust, northern red oak, silver maple.	Eastern cottonwood.
33---------------- Zook	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Honeylocust, golden willow, green ash, northern red oak, silver maple, Austrian pine.	Eastern cottonwood.
35---------------- Booker	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Austrian pine, honeylocust, green ash, silver maple, golden willow, northern red oak.	Eastern cottonwood.
36---------------- Bremer	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Austrian pine, honeylocust, green ash, silver maple, golden willow, northern red oak.	Eastern cottonwood.
37---------------- Moniteau	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Green ash, Austrian pine, silver maple, honeylocust, northern red oak, golden willow.	Eastern cottonwood.
38---------------- Wiota	---	Lilac, Amur honeysuckle, autumn-olive, Amur maple.	Eastern redcedar, hackberry, green ash, bur oak, Russian-olive.	Austrian pine, eastern white pine, honeylocust.	---
39---------------- Nodaway	---	Amur honeysuckle, autumn-olive, Amur maple, lilac.	Eastern redcedar	Austrian pine, hackberry, honeylocust, green ash, eastern white pine, pin oak.	Eastern cottonwood.
41C2, 41D2, 42C3, 42E3------------- Armster	---	Lilac, autumn-olive, Amur honeysuckle, Amur maple.	Eastern redcedar, hackberry, green ash, bur oak, Russian-olive.	Austrian pine, eastern white pine, honeylocust.	---
54C2, 54E2, 54F, 55D3------------- Knox	---	Amur honeysuckle, autumn-olive, lilac, Amur maple.	Hackberry, eastern redcedar, green ash, bur oak, 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 heights, in feet, of-- <8	8-15	16-25	26-35	>35
56B, 57C2: Grundy	Lilac	Siberian peashrub, Manchurian crabapple, Amur honeysuckle, autumn-olive.	Eastern redcedar, hackberry, Russian-olive, Austrian pine, green ash, jack pine.	Honeylocust	---
61C*, 61D*, 61E*: Knox	---	Amur honeysuckle, autumn-olive, lilac, Amur maple.	Hackberry, eastern redcedar, green ash, bur oak, Russian-olive.	Austrian pine, eastern white pine, honeylocust.	---
Urban land.					
68C*, 69A*. Urban land					
70B*, 70C*, 70D*: Sharpsburg	---	Amur maple, Amur honeysuckle, lilac, autumn-olive.	Green ash, hackberry, bur oak, eastern redcedar, Russian-olive.	Austrian pine, eastern white pine, honeylocust.	---
Urban land.					
71: Aholt	---	American plum, common chokecherry.	Hackberry, eastern redcedar, white spruce, Manchurian crabapple.	Austrian pine, golden willow, green ash, honey-locust, Russian mulberry.	Eastern cottonwood.
72: Dockery	---	Amur honeysuckle, lilac, autumn-olive, Amur maple.	Eastern redcedar, pin oak.	Austrian pine, eastern white pine, honeylocust, hackberry, green ash.	Eastern cottonwood.
73: Leta	Blackhaw	Tatarian honeysuckle, Siberian peashrub.	Eastern redcedar, osageorange, Russian-olive, Washington hawthorn.	Honeylocust, hackberry, green ash, bur oak.	Eastern cottonwood.
74: Levasy	---	American plum, common chokecherry.	Manchurian crabapple, hackberry, eastern redcedar, white spruce.	Russian mulberry, Austrian pine, green ash, golden willow, honeylocust.	Eastern cottonwood.
75: Norborne	---	Autumn-olive, Amur honeysuckle, Amur maple, lilac.	Eastern redcedar	Honeylocust, pin oak, eastern white pine, Austrian pine, hackberry, green ash.	Eastern cottonwood.
78: Myrick	---	Common chokecherry, American plum.	Hackberry, Manchurian crabapple, eastern redcedar, white spruce.	Austrian pine, golden willow, Russian mulberry, honeylocust, green ash.	Eastern cottonwood.
80: Landes	---	Amur maple, autumn-olive, lilac, Amur honeysuckle.	Austrian pine, eastern redcedar.	Eastern white pine, hackberry, green ash, 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 heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
81 Waldron	Blackhaw	Tatarian honeysuckle, Siberian peashrub.	Eastern redcedar, Russian-olive, osageorange, Washington hawthorn.	Honeylocust, hackberry, green ash, bur oak.	Eastern cottonwood.
82 Parkville	Blackhaw	Tatarian honeysuckle, Siberian peashrub.	Eastern redcedar, Russian-olive, osageorange, Washington hawthorn.	Honeylocust, hackberry, green ash, bur oak.	Eastern cottonwood.
83 Haynie	Blackhaw	Tatarian honeysuckle, Siberian peashrub.	Russian-olive, osageorange, eastern redcedar, Washington hawthorn.	Green ash, hackberry, honeylocust, bur oak.	Eastern cottonwood.
87 Modale	Blackhaw	Tatarian honeysuckle, Siberian peashrub.	Russian-olive, bur oak, eastern redcedar, Washington hawthorn.	Honeylocust, green ash, hackberry, bur oak.	Eastern cottonwood.
88 Gilliam	Blackhaw	Tatarian honeysuckle, Siberian peashrub.	Osageorange, eastern redcedar, Russian-olive, Washington hawthorn.	Honeylocust, hackberry, bur oak, green ash.	Eastern cottonwood.
89 Sarpy	Siberian peashrub	Amur honeysuckle, autumn-olive, lilac, Russian-olive, Tatarian honeysuckle, bur oak, osageorange.	Austrian pine, eastern redcedar, jack pine.	Eastern cottonwood	---
90 Wabash	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Austrian pine, green ash, golden willow, honeylocust.	Eastern cottonwood.
92 Cotter	---	Autumn-olive, Amur maple, lilac, Amur honeysuckle.	Green ash, hackberry, bur oak, eastern redcedar, Russian-olive.	Eastern white pine, Austrian pine, honeylocust.	---

* 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	Golf fairways
1B-------------------- Sibley	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
1C-------------------- Sibley	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
2C-------------------- Higginsville	Moderate: wetness.	Moderate: wetness.	Severe: slope.	Moderate: wetness.	Moderate: wetness.
5C-------------------- Macksburg	Moderate: percs slowly, wetness.	Moderate: percs slowly, wetness.	Severe: slope.	Slight----------	Slight.
6B-------------------- Sharpsburg	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight----------	Slight.
6C2------------------- Sharpsburg	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight----------	Slight.
6D2------------------- Sharpsburg	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight----------	Moderate: slope.
8*. Pits					
9D-------------------- Snead	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Severe: thin layer.
9E-------------------- Snead	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope, thin layer.
10D*:					
Snead----------------	Moderate: large stones.	Moderate: large stones.	Severe: large stones, slope, small stones.	Moderate: large stones.	Severe: large stones.
Rock outcrop.					
10F*:					
Snead----------------	Severe: slope.	Severe: slope.	Severe: large stones, slope, small stones.	Moderate: large stones.	Severe: large stones, slope.
Rock outcrop.					
11C2------------------ Greenton	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
11C3, 11D3------------ Greenton	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness, slope.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
13B----------------- Sampsel	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
13C----------------- Sampsel	Severe: wetness.	Severe: wetness.	Severe: slope.	Severe: wetness.	Severe: wetness.
24B----------------- Lagonda	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
25C2---------------- Lagonda	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Moderate: wetness.	Moderate: wetness.
25D2---------------- Lagonda	Moderate: slope, wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: wetness, slope.
26B----------------- Ladoga	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight----------	Slight.
26C2---------------- Ladoga	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight----------	Slight.
26D2, 27D3---------- Ladoga	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight----------	Moderate: slope.
31------------------ Colo	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
33------------------ Zook	Severe: wetness, flooding.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
35------------------ Booker	Severe: flooding, ponding, percs slowly.	Severe: ponding, too clayey, percs slowly.	Severe: too clayey, ponding.	Severe: ponding, too clayey.	Severe: ponding, too clayey.
36------------------ Bremer	Severe: wetness, flooding.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
37------------------ Moniteau	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
38------------------ Wiota	Severe: flooding.	Slight----------	Slight----------	Slight----------	Slight.
39------------------ Nodaway	Severe: flooding.	Slight----------	Moderate: flooding.	Slight----------	Moderate: flooding.
41C2---------------- Armster	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Severe: erodes easily.	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	Golf fairways
41D2------------------- Armster	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
42C3------------------- Armster	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Severe: erodes easily.	Slight.
42E3------------------- Armster	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
54C2------------------- Knox	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
54E2------------------- Knox	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
54F-------------------- Knox	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
55D3------------------- Knox	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
56B-------------------- Grundy	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
57C2------------------- Grundy	Severe: wetness.	Moderate: wetness.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
61C*:					
Knox------------------	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
Urban land.					
61D*:					
Knox------------------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
Urban land.					
61E*:					
Knox------------------	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Urban land.					
68C*, 69A*. Urban land					
70B*:					
Sharpsburg------------	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight----------	Slight.
Urban land.					
70C*:					
Sharpsburg------------	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight----------	Slight.
Urban land.					

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
70D*:					
Sharpsburg	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.
Urban land.					
71 Aholt	Severe: flooding, wetness, percs slowly.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey, wetness.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
72 Dockery	Severe: flooding.	Moderate: wetness.	Moderate: wetness, flooding.	Slight	Moderate: flooding.
73 Leta	Severe: flooding, wetness, too clayey.	Severe: too clayey.	Severe: too clayey, wetness.	Severe: too clayey.	Severe: too clayey.
74 Levasy	Severe: flooding, ponding, too clayey.	Severe: ponding, too clayey.	Severe: too clayey, ponding.	Severe: ponding, too clayey.	Severe: ponding, too clayey.
75 Norborne	Severe: flooding.	Slight	Slight	Slight	Slight.
78 Myrick	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
80 Landes	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: droughty, flooding.
81 Waldron	Severe: wetness, flooding.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
82 Parkville	Severe: flooding, wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Severe: too clayey.	Severe: too clayey.
83 Haynie	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
87 Modale	Severe: flooding, wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness, flooding.
88 Gilliam	Severe: flooding.	Moderate: wetness.	Moderate: wetness, flooding.	Moderate: wetness.	Moderate: wetness, flooding.
89 Sarpy	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: droughty, flooding.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
90-------------------- Wabash	Severe: flooding, wetness, percs slowly.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey, wetness.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
92-------------------- Cotter	Severe: flooding.	Slight----------	Slight----------	Slight----------	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT POTENTIALS

[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	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
1B------------------ Sibley	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
1C------------------ Sibley	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
2C------------------ Higginsville	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
5C------------------ Macksburg	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
6B------------------ Sharpsburg	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
6C2, 6D2----------- Sharpsburg	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
8*. Pits										
9D------------------ Snead	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
9E------------------ Snead	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
10D*:										
Snead--------------	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Rock outcrop.										
10F*:										
Snead--------------	Very poor.	Very poor.	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Rock outcrop.										
11C2---------------- Greenton	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
11C3, 11D3---------- Greenton	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
13B, 13C----------- Sampsel	Fair	Fair	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
24B, 25C2, 25D2---- Lagonda	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
26B----------------- Ladoga	Good	Good	Fair	Good	Good	Poor	Poor	Good	Good	Poor.
26C2, 26D2---------- Ladoga	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Very poor.
27D3---------------- Ladoga	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
31------------------ Colo	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
33------------------ Zook	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
35------------------ Booker	Poor	Poor	Fair	Poor	Poor	Poor	Good	Poor	Poor	Fair.
36------------------ Bremer	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
37------------------ Moniteau	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
38------------------ Wiota	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
39------------------ Nodaway	Good	Good	Good	Good	Fair	Fair	Poor	Good	Good	Fair.
41C2, 41D2, 42C3--- Armster	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
42E3--------------- Armster	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
54C2--------------- Knox	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
54E2--------------- Knox	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
54F---------------- Knox	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
55D3--------------- Knox	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
56B---------------- Grundy	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
57C2--------------- Grundy	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
61C*, 61D*:										
Knox---------------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Urban land.										
61E*:										
Knox---------------	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Urban land.										
68C*, 69A*. Urban land										
70B*:										
Sharpsburg---------	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Urban land.										
70C*, 70D*:										
Sharpsburg---------	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Urban land.										

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
71------------------ Aholt	Fair	Fair	Fair	Poor	Poor	Poor	Good	Fair	Poor	Fair.
72------------------ Dockery	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
73------------------ Leta	Fair	Fair	Fair	Good	Good	Poor	Fair	Fair	Fair	Poor.
74------------------ Levasy	Fair	Fair	Fair	Fair	Fair	Poor	Good	Fair	Fair	Fair.
75------------------ Norborne	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
78------------------ Myrick	Poor	Fair	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
80------------------ Landes	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
81------------------ Waldron	Fair	Fair	Fair	Good	Good	Poor	Fair	Fair	Fair	Poor.
82------------------ Parkville	Fair	Fair	Fair	Good	Good	Poor	Fair	Fair	Good	Poor.
83------------------ Haynie	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
87------------------ Modale	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Good.
88------------------ Gilliam	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
89------------------ Sarpy	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
90------------------ Wabash	Poor	Poor	Poor	Poor	Poor	Poor	Good	Poor	Poor	Fair.
92------------------ Cotter	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.

* 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 and 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	Lawns and landscaping
1B Sibley	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
1C Sibley	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
2C Higginsville	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell, slope.	Severe: low strength, frost action.	Moderate: wetness.
5C Macksburg	Severe: wetness.	Severe: shrink-swell.	Severe: wetness.	Severe: shrink-swell.	Severe: low strength, frost action, shrink-swell.	Slight.
6B Sharpsburg	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
6C2 Sharpsburg	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
6D2 Sharpsburg	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
8*. Pits						
9D Snead	Severe: wetness.	Severe: shrink-swell.	Severe: wetness.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Severe: thin layer.
9E Snead	Severe: wetness, slope.	Severe: shrink-swell, slope.	Severe: wetness, slope.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope, thin layer.
10D*: Snead	Severe: wetness.	Severe: shrink-swell.	Severe: wetness.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Severe: large stones, thin layer.
Rock outcrop.						
10F*: Snead	Severe: wetness, slope.	Severe: shrink-swell, slope.	Severe: wetness, slope.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: large stones, slope, thin layer.
Rock outcrop.						
11C2 Greenton	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell.	Moderate: wetness.
11C3, 11D3 Greenton	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: wetness, slope.

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	Lawns and landscaping
13B, 13C----------- Sampsel	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, wetness.	Severe: low strength, frost action, wetness.	Severe: wetness.
24B, 25C2---------- Lagonda	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
25D2--------------- Lagonda	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness, slope.
26B---------------- Ladoga	Slight----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
26C2--------------- Ladoga	Slight----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
26D2, 27D3--------- Ladoga	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
31----------------- Colo	Severe: wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, low strength, frost action.	Moderate: wetness, flooding.
33----------------- Zook	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, low strength, frost action.	Moderate: wetness, flooding.
35----------------- Booker	Severe: ponding.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: low strength, ponding, flooding.	Severe: ponding, too clayey.
36----------------- Bremer	Severe: wetness.	Severe: wetness, shrink-swell, flooding.	Severe: wetness, shrink-swell, flooding.	Severe: wetness, shrink-swell, flooding.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
37----------------- Moniteau	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness.	Severe: wetness.
38----------------- Wiota	Slight----------	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, frost action.	Slight.
39----------------- Nodaway	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, frost action, low strength.	Moderate: flooding.
41C2--------------- Armster	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.

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	Lawns and landscaping
41D2: Armster	Moderate: too clayey, wetness, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: slope.
42C3: Armster	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
42E3: Armster	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope.
54C2: Knox	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
54E2, 54F: Knox	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
55D3: Knox	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
56B, 57C2: Grundy	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
61C*:						
Knox	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
Urban land.						
61D*:						
Knox	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
Urban land.						
61E*:						
Knox	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
Urban land.						
68C*, 69A*. Urban land						
70B*:						
Sharpsburg	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
Urban land.						
70C*:						
Sharpsburg	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
Urban land.						

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	Lawns and landscaping
70D*:						
Sharpsburg	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
Urban land.						
71 Aholt	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, flooding.	Severe: wetness, too clayey.
72 Dockery	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, flooding, frost action.	Moderate: flooding.
73 Leta	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, flooding, frost action.	Severe: too clayey.
74 Levasy	Severe: ponding.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding.	Severe: flooding, ponding, shrink-swell.	Severe: low strength, ponding, flooding.	Severe: ponding, too clayey.
75 Norborne	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: low strength, flooding, frost action.	Slight.
78 Myrick	Severe: ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding, frost action.	Severe: ponding.
80 Landes	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding.
81 Waldron	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
82 Parkville	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding.	Severe: too clayey.
83 Haynie	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding, frost action.	Moderate: flooding.
87 Modale	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
88 Gilliam	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
89 Sarpy	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding.

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	Lawns and landscaping
90----------------- Wabash	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, flooding.	Severe: wetness, too clayey.
92----------------- Cotter	Slight----------	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, frost action.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition and 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
1B Sibley	Slight	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
1C Sibley	Slight	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
2C Higginsville	Severe: wetness.	Severe: slope, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey, wetness.
5C Macksburg	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
6B Sharpsburg	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
6C2 Sharpsburg	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
6D2 Sharpsburg	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
8*. Pits					
9D Snead	Severe: depth to rock, wetness.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
9E Snead	Severe: depth to rock, wetness, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
10D*:					
Snead	Severe: depth to rock, wetness, percs slowly.	Severe: depth to rock, slope, wetness.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Rock outcrop.					
10F*:					
Snead	Severe: depth to rock, wetness, percs slowly.	Severe: depth to rock, slope, wetness.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
Rock outcrop.					
11C2, 11C3, 11D3 Greenton	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
13B Sampsel	Severe: wetness, percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.

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
13C Sampsel	Severe: wetness, percs slowly.	Severe: slope.	Severe: depth to rock, wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
24B Lagonda	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
25C2 Lagonda	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
25D2 Lagonda	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Moderate: wetness, slope.	Poor: too clayey, hard to pack.
26B Ladoga	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
26C2 Ladoga	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
26D2, 27D3 Ladoga	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.
31 Colo	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Poor: wetness, hard to pack.
33 Zook	Severe: percs slowly, wetness, flooding.	Severe: flooding.	Severe: wetness, too clayey, flooding.	Severe: wetness, flooding.	Poor: too clayey, wetness, hard to pack.
35 Booker	Severe: flooding, ponding, percs slowly.	Slight	Severe: flooding, ponding, too clayey.	Severe: flooding, ponding.	Poor: too clayey, hard to pack, ponding.
36 Bremer	Severe: percs slowly, flooding, wetness.	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Poor: wetness.
37 Moniteau	Severe: wetness, percs slowly.	Slight	Severe: wetness.	Severe: wetness.	Poor: wetness.
38 Wiota	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
39 Nodaway	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.
41C2, 41D2, 42C3 Armster	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: wetness, too clayey.	Severe: wetness.	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
42E3----------------- Armster	Severe: wetness, percs slowly, slope.	Severe: slope, wetness.	Severe: wetness, slope, too clayey.	Severe: wetness, slope.	Poor: too clayey, hard to pack, slope.
54C2----------------- Knox	Slight-----------	Severe: slope.	Slight-----------	Slight-----------	Good.
54E2, 54F------------ Knox	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
55D3----------------- Knox	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
56B------------------ Grundy	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
57C2----------------- Grundy	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
61C*:					
Knox-----------------	Slight-----------	Severe: slope.	Slight-----------	Slight-----------	Good.
Urban land.					
61D*:					
Knox-----------------	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Urban land.					
61E*:					
Knox-----------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Urban land.					
68C*, 69A*. Urban land					
70B*:					
Sharpsburg-----------	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
Urban land.					
70C*:					
Sharpsburg-----------	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
Urban land.					
70D*:					
Sharpsburg-----------	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Urban land.					

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
71 Aholt	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
72 Dockery	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: too clayey, wetness.
73 Leta	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
74 Levasy	Severe: flooding, ponding, percs slowly.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Poor: ponding.
75 Norborne	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
78 Myrick	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Poor: ponding.
80 Landes	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage.	Poor: seepage, too sandy.
81 Waldron	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
82 Parkville	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: wetness.
83 Haynie	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
87 Modale	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
88 Gilliam	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: too clayey, wetness.
89 Sarpy	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, too sandy.	Severe: flooding, seepage.	Poor: seepage, too sandy.
90 Wabash	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
92 Cotter	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition and does not eliminate the need for onsite investigation]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1B, 1C Sibley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
2C Higginsville	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
5C Macksburg	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
6B, 6C2, 6D2 Sharpsburg	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
8*. Pits				
9D, 9E Snead	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
10D*, 10F*: Snead	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones.
Rock outcrop.				
11C2, 11C3, 11D3 Greenton	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
13B, 13C Sampsel	Poor: low strength, shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
24B, 25C2, 25D2 Lagonda	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
26B, 26C2, 26D2, 27D3 Ladoga	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
31 Colo	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
33 Zook	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
35 Booker	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
36 Bremer	Poor: shrink-swell, 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
37: Moniteau	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
38: Wiota	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
39: Nodaway	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
41C2, 41D2, 42C3: Armster	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
42E3: Armster	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
54C2: Knox	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
54E2: Knox	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
54F: Knox	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
55D3: Knox	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
56B, 57C2: Grundy	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
61C*:				
Knox	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Urban land.				
61D*:				
Knox	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Urban land.				
61E*:				
Knox	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Urban land.				
68C*, 69A*. Urban land				
70B*, 70C*, 70D*:				
Sharpsburg	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Urban land.				
71: Aholt	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
72: Dockery	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
73: Leta	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
74: Levasy	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
75: Norborne	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
78: Myrick	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
80: Landes	Good	Probable	Improbable: too sandy.	Poor: thin layer.
81: Waldron	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
82: Parkville	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
83: Haynie	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
87: Modale	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
88: Gilliam	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
89: Sarpy	Good	Probable	Improbable: too sandy.	Poor: too sandy.
90: Wabash	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
92: Cotter	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.

* 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 and 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
1B, 1C: Sibley	Moderate: seepage, slope.	Slight	Deep to water	Slope	Favorable	Favorable.
2C: Higginsville	Moderate: slope, seepage.	Moderate: wetness.	Frost action, slope.	Wetness, slope, erodes easily.	Erodes easily, wetness.	Erodes easily.
5C: Macksburg	Moderate: seepage, slope.	Moderate: wetness.	Frost action, slope.	Wetness, slope.	Erodes easily, wetness.	Erodes easily.
6B, 6C2: Sharpsburg	Moderate: seepage, slope.	Slight	Deep to water	Slope	Erodes easily	Erodes easily.
6D2: Sharpsburg	Severe: slope.	Slight	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
8*. Pits						
9D, 9E: Snead	Severe: depth to rock, slope.	Severe: thin layer.	Percs slowly, depth to rock, slope.	Wetness, percs slowly.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
10D*, 10F*:						
Snead	Severe: slope.	Severe: large stones.	Percs slowly, depth to rock, large stones.	Large stones, wetness.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
Rock outcrop.						
11C2: Greenton	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Wetness, erodes easily.
11C3, 11D3: Greenton	Severe: slope.	Moderate: hard to pack, wetness.	Percs slowly, slope.	Wetness, percs slowly, slope.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
13B, 13C: Sampsel	Moderate: depth to rock, slope.	Severe: hard to pack, wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Erodes easily, wetness.
24B, 25C2: Lagonda	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Erodes easily, percs slowly.
25D2: Lagonda	Severe: slope.	Moderate: hard to pack, wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Slope, erodes easily, wetness.	Slope, erodes easily, percs slowly.
26B, 26C2: Ladoga	Moderate: seepage, slope.	Moderate: hard to pack.	Deep to water	Slope	Erodes easily	Erodes easily.
26D2, 27D3: Ladoga	Severe: slope.	Moderate: hard to pack.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
31: Colo	Moderate: seepage.	Severe: wetness.	Flooding, frost action.	Flooding, wetness.	Wetness	Wetness.
33: Zook	Slight	Severe: hard to pack, wetness.	Flooding, percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
35 Booker	Slight	Severe: hard to pack, ponding.	Ponding, percs slowly, flooding.	Ponding, slow intake, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
36 Bremer	Slight	Severe: wetness, hard to pack.	Flooding, frost action.	Wetness, flooding.	Wetness	Wetness.
37 Moniteau	Slight	Severe: wetness.	Frost action	Wetness, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily.
38 Wiota	Moderate: seepage.	Slight	Deep to water	Favorable	Erodes easily	Erodes easily.
39 Nodaway	Moderate: seepage.	Severe: piping.	Deep to water	Flooding, erodes easily.	Erodes easily	Erodes easily.
41C2 Armster	Moderate: slope.	Moderate: hard to pack, wetness.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
41D2 Armster	Severe: slope.	Moderate: hard to pack, wetness.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
42C3 Armster	Moderate: slope.	Moderate: hard to pack, wetness.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
42E3 Armster	Severe: slope.	Moderate: hard to pack, wetness.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
54C2 Knox	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
54E2, 54F, 55D3 Knox	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
56B, 57C2 Grundy	Moderate: slope.	Severe: hard to pack.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Wetness, erodes easily.
61C*: Knox	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
Urban land.						
61D*, 61E*: Knox	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Urban land.						
68C*, 69A*. Urban land						
70B*, 70C*: Sharpsburg	Moderate: seepage, slope.	Slight	Deep to water	Slope	Erodes easily	Erodes easily.
Urban land.						
70D*: Sharpsburg	Severe: slope.	Slight	Deep to water	Slope	Slope, erodes easily.	Slope, 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
70D*: Urban land.						
71----------------- Aholt	Slight---------	Severe: hard to pack, wetness.	Percs slowly, flooding.	Wetness, slow intake, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
72----------------- Dockery	Moderate: seepage.	Moderate: piping, wetness.	Flooding, frost action.	Wetness, erodes easily, flooding.	Erodes easily, wetness.	Erodes easily.
73----------------- Leta	Moderate: seepage.	Severe: piping, wetness.	Percs slowly, flooding, frost action.	Wetness, slow intake, percs slowly.	Wetness---------	Wetness, percs slowly.
74----------------- Levasy	Moderate: seepage.	Severe: piping, ponding.	Ponding, percs slowly, flooding.	Ponding, slow intake, percs slowly.	Erodes easily, ponding.	Wetness, erodes easily, percs slowly.
75----------------- Norborne	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Favorable------	Favorable.
78----------------- Myrick	Moderate: seepage.	Severe: piping, ponding.	Ponding, percs slowly, flooding.	Ponding, percs slowly.	Ponding---------	Wetness, percs slowly.
80----------------- Landes	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, flooding.	Too sandy, soil blowing.	Droughty.
81----------------- Waldron	Slight---------	Severe: hard to pack.	Percs slowly, flooding, frost action.	Wetness, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
82----------------- Parkville	Moderate: seepage.	Severe: piping, wetness.	Percs slowly, flooding, cutbanks cave.	Wetness, slow intake, percs slowly.	Wetness---------	Wetness, percs slowly.
83----------------- Haynie	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily, flooding.	Erodes easily	Erodes easily.
87----------------- Modale	Moderate: seepage.	Severe: hard to pack, wetness.	Percs slowly, flooding, frost action.	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
88----------------- Gilliam	Moderate: seepage.	Severe: wetness, piping.	Flooding, frost action.	Wetness, flooding.	Wetness---------	Favorable.
89----------------- Sarpy	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
90----------------- Wabash	Slight---------	Severe: hard to pack, wetness.	Percs slowly, flooding.	Wetness, droughty, slow intake.	Wetness, percs slowly.	Wetness, droughty, percs slowly.
92----------------- Cotter	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1B, 1C----------- Sibley	0-11	Silt loam--------	CL	A-6	0	100	100	95-100	90-100	30-40	10-20
	11-49	Silty clay loam	CL, CH, MH	A-7	0	100	100	95-100	90-100	40-55	20-35
	49-72	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	90-100	35-45	15-25
2C--------------- Higginsville	0-10	Silt loam--------	CL	A-6	0	100	100	95-100	95-100	30-40	10-15
	10-15	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	15-25
	15-49	Silty clay loam	CL	A-7	0	100	100	95-100	90-100	40-50	15-25
	49-60	Silty clay loam, silt loam.	CL, ML	A-6, A-7	0	100	100	95-100	90-100	35-45	10-20
5C--------------- Macksburg	0-19	Silt loam--------	ML, OL, MH, OH	A-7	0	100	100	100	95-100	40-55	15-25
	19-48	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-60	20-35
	48-61	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
6B, 6C2, 6D2----- Sharpsburg	0-17	Silt loam--------	CL	A-6	0	100	100	100	95-100	25-40	10-20
	17-55	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-60	20-35
	55-60	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
8*. Pits											
9D, 9E----------- Snead	0-5	Silty clay loam	CL	A-6, A-7	0-10	90-100	90-100	90-100	80-95	30-45	10-25
	5-35	Silty clay, clay	CH, CL	A-7	0-10	90-100	90-100	90-100	80-100	45-60	25-40
	35-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
10D*, 10F*: Snead-----------	0-12	Flaggy silty clay loam.	CL, CH	A-7	10-40	70-90	60-85	55-80	50-75	35-55	20-35
	12-19	Flaggy silty clay, flaggy clay, stony silty clay.	CH, CL	A-7	10-50	70-90	60-85	55-80	50-75	45-60	25-40
	19-38	Silty clay, clay	CH, CL	A-7	0-10	90-100	90-100	90-100	80-100	45-60	25-40
	38-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Rock outcrop.											
11C2------------- Greenton	0-11	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-45	15-25
	11-49	Silty clay loam, silty clay.	CH	A-7	0	100	100	95-100	95-100	50-70	35-45
	49-60	Silty clay, clay, channery silty clay.	CH	A-7	0-5	65-100	65-100	60-95	55-90	50-70	25-40
11C3, 11D3------- Greenton	0-6	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-45	15-25
	6-37	Silty clay loam, silty clay.	CH	A-7	0	100	100	95-100	95-100	50-70	35-45
	37-60	Silty clay, clay, channery silty clay.	CH	A-7	0-5	65-100	65-100	60-95	55-90	50-70	25-40
13B, 13C--------- Sampsel	0-15	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-99	35-50	15-25
	15-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	97-100	95-100	52-75	35-47

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

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	
24B--------------- Lagonda	0-6	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	90-100	20-40	5-15
	6-15	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	95-100	95-100	40-70	25-40
	15-55	Silty clay loam, silty clay, clay loam.	CL, CH	A-7	0	95-100	90-100	80-95	75-90	45-60	25-40
	55-60	Clay loam, clay	CL, CH	A-7	0	95-100	90-100	90-100	75-90	40-65	25-40
25C2, 25D2------- Lagonda	0-9	Silty clay loam	CL	A-7	0	100	100	95-100	90-100	40-50	15-25
	9-32	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	95-100	95-100	40-70	25-40
	32-60	Clay loam, clay	CL, CH	A-7	0	95-100	90-100	90-100	75-90	40-65	25-40
26B, 26C2, 26D2-- Ladoga	0-11	Silt loam--------	CL, CL-ML	A-6, A-4	0	100	100	100	95-100	25-40	5-15
	11-46	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	100	95-100	40-55	25-35
	46-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	100	95-100	30-40	15-20
27D3------------- Ladoga	0-4	Silty clay loam	CL, CL-ML	A-6, A-4	0	100	100	100	95-100	25-40	5-15
	4-41	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	100	95-100	40-55	25-35
	41-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	100	95-100	30-40	15-20
31--------------- Colo	0-28	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	28-48	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
	48-60	Silty clay loam, clay loam, silt loam.	CL, CH	A-7	0	100	100	95-100	80-100	40-55	15-30
33--------------- Zook	0-37	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	45-65	20-35
	37-66	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
35--------------- Booker	0-19	Silty clay-------	CL, CH	A-7	0	100	100	95-100	95-100	45-75	30-45
	19-60	Clay-------------	CH	A-7	0	100	100	100	95-100	65-85	40-55
36--------------- Bremer	0-14	Silt loam--------	CH, CL	A-7	0	100	100	100	95-100	45-60	25-40
	14-50	Silty clay loam, silty clay.	CH, MH	A-7	0	100	100	100	95-100	50-65	20-35
	50-60	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	40-60	25-40
37--------------- Moniteau	0-16	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	90-100	85-100	25-35	5-15
	16-64	Silty clay loam	CL	A-6, A-7	0	100	100	85-100	80-95	30-45	15-25
38--------------- Wiota	0-12	Silt loam--------	CL	A-6	0	100	100	100	90-95	30-40	10-20
	12-49	Silty clay loam	CL	A-7	0	100	100	95-100	90-95	40-50	15-25
	49-60	Silty clay loam, silt loam.	CL	A-7	0	100	100	95-100	90-95	40-50	20-30
39--------------- Nodaway	0-60	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-35	5-15
41C2, 41D2------- Armster	0-6	Loam-------------	CL	A-6	0	95-100	80-95	75-90	55-80	25-40	11-20
	6-41	Clay loam, sandy clay, clay.	CL, CH	A-7	0	95-100	80-95	70-90	55-80	45-60	25-35
	41-60	Silty clay loam, clay loam, sandy clay loam.	CL	A-6, A-7	0	95-100	80-95	70-90	55-80	30-45	15-25
42C3, 42E3------- Armster	0-5	Clay loam--------	CL	A-7	0	95-100	80-95	70-90	55-80	40-50	25-35
	5-60	Clay loam, clay	CL, CH	A-7	0	95-100	80-95	70-90	55-80	45-60	25-35
54C2, 54E2, 54F-- Knox	0-7	Silt loam--------	CL-ML, CL, ML	A-4, A-6	0	100	100	95-100	90-100	20-35	2-15
	7-40	Silty clay loam, silt loam.	CL	A-7	0	100	100	95-100	95-100	40-50	20-30
	40-60	Silt loam--------	CL	A-6, A-7	0	100	100	95-100	90-100	30-45	10-25

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
55D3-------------- Knox	0-5	Silty clay loam	CL	A-6	0	100	100	95-100	95-100	30-35	10-15
	5-58	Silty clay loam, silt loam.	CL	A-7	0	100	100	95-100	95-100	40-50	20-30
	58-65	Silt loam--------	CL	A-6, A-7	0	100	100	95-100	90-100	30-45	10-25
56B-------------- Grundy	0-6	Silt loam--------	CL	A-6, A-7	0	100	100	95-100	90-100	30-45	10-20
	6-15	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	95-100	90-100	45-55	25-35
	15-36	Silty clay-------	CH	A-7	0	100	100	95-100	90-100	50-70	30-45
	36-60	Silty clay loam	CH, CL	A-7	0	100	100	90-100	90-100	40-55	25-35
57C2------------- Grundy	0-8	Silty clay loam	CH, CL	A-7	0	100	100	95-100	90-100	40-55	20-35
	8-43	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	95-100	90-100	45-55	25-35
	43-60	Silty clay loam	CH, CL	A-7	0	100	100	90-100	90-100	40-55	25-35
61C*, 61D*, 61E*:											
Knox------------	0-7	Silt loam--------	CL-ML, CL, ML	A-4, A-6	0	100	100	95-100	90-100	20-35	2-15
	7-40	Silty clay loam, silt loam.	CL	A-7	0	100	100	95-100	95-100	40-50	20-30
	40-60	Silt loam--------	CL	A-6, A-7	0	100	100	95-100	90-100	30-45	10-25
Urban land.											
68C*, 69A*. Urban land											
70B*, 70C*, 70D*:											
Sharpsburg------	0-17	Silt loam--------	CL	A-6	0	100	100	100	95-100	25-40	10-20
	17-55	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-60	20-35
	55-60	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
Urban land.											
71--------------- Aholt	0-46	Clay-------------	CH	A-7-6	0	100	100	95-100	90-100	60-80	35-55
	46-66	Silty clay, silty clay loam.	CL, CH	A-7-6	0	100	100	85-100	85-100	45-60	30-40
72--------------- Dockery	0-14	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	90-100	85-100	25-35	5-15
	14-60	Stratified silt loam to silty clay loam.	CL	A-4, A-6	0	100	100	90-100	85-95	25-40	8-20
73--------------- Leta	0-14	Silty clay-------	CL, CH	A-7	0	100	100	95-100	95-100	45-65	30-45
	14-34	Silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	95-100	90-100	35-65	20-40
	34-60	Stratified silt loam to sandy loam.	CL-ML, CL	A-4, A-6	0	100	100	80-100	51-95	20-35	5-15
74--------------- Levasy	0-32	Silty clay-------	CH, CL	A-7	0	100	100	95-100	85-95	40-60	20-40
	32-60	Very fine sandy loam, silt loam, fine sandy loam.	CL, SC, CL-ML, SM-SC	A-6, A-4	0	100	100	70-95	40-75	20-40	4-15
75--------------- Norborne	0-17	Very fine sandy loam.	CL	A-4	0	100	100	90-100	60-75	<20	2-6
	17-45	Loam, very fine sandy loam, silt loam.	CL-ML, CL	A-4	0	100	100	90-100	60-75	<25	5-10
	45-60	Fine sandy loam, very fine sandy loam, loam.	ML, CL-ML	A-4	0	100	100	85-100	50-75	<20	2-6
78--------------- Myrick	0-13	Silty clay loam, silty clay.	CH	A-7	0	100	100	95-100	90-100	50-60	30-40
	13-60	Very fine sandy loam, silt loam.	ML, CL, CL-ML	A-4	0	100	100	85-95	80-95	<25	NP-8

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
80---------------- Landes	0-27	Fine sandy loam	SM, SC, SM-SC	A-4, A-2	0	100	95-100	85-95	20-50	<25	NP-10
	27-68	Stratified fine sand to silt loam.	SM, ML, SP-SM, SC	A-2, A-4	0	100	95-100	60-95	10-70	<30	NP-10
81---------------- Waldron	0-9	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	30-45	15-25
	9-60	Stratified silty clay loam to clay.	CL, CH	A-7	0	100	100	95-100	90-100	40-65	20-45
82---------------- Parkville	0-19	Silty clay--------	CH	A-7	0	100	100	97-100	95-100	55-80	30-55
	19-72	Stratified loamy very fine sand to silt loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	20-35	NP-15
83---------------- Haynie	0-9	Silt 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, loamy fine sand.	CL-ML, CL	A-4, A-6	0	100	100	85-100	85-100	25-35	5-15
87---------------- Modale	0-20	Silt loam, very fine sandy loam.	CL	A-4, A-6	0	100	100	95-100	70-90	25-40	8-18
	20-60	Silty clay, clay	CH	A-7	0	100	100	95-100	95-100	65-85	40-60
88---------------- Gilliam	0-17	Silt loam---------	CL	A-6, A-4	0	100	100	95-100	85-100	25-40	8-20
	17-51	Silt loam, silty clay loam, loam.	CL	A-6, A-4	0	100	100	90-100	80-95	25-40	8-20
	51-60	Stratified silty clay loam to loam.	CL-ML, CL	A-4, A-6	0	100	100	90-100	80-95	20-40	5-20
89---------------- Sarpy	0-6	Loamy fine sand	SM	A-2-4	0	100	100	60-80	15-35	---	NP
	6-60	Fine sand, loamy fine sand, sand.	SM, SP, SP-SM	A-2-4, A-3	0	100	100	60-80	2-35	---	NP
90---------------- Wabash	0-6	Silty clay--------	CH	A-7	0	100	100	100	95-100	50-75	30-50
	6-66	Silty clay, clay	CH	A-7	0	100	100	100	95-100	52-78	30-55
92---------------- Cotter	0-20	Silt loam---------	CL	A-6	0	100	100	90-100	80-95	30-40	13-20
	20-40	Silty clay loam, silt loam.	CL	A-6	0	100	100	95-100	80-90	30-40	14-22
	40-60	Loam, silt loam	CL	A-4, A-6	0	100	100	90-100	65-80	25-40	8-18

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm^3	In/hr	In/in	pH					Pct
1B, 1C----------- Sibley	0-11	20-30	1.20-1.50	0.6-2.0	0.19-0.21	5.6-7.8	Moderate-----	0.28	5	6	3-4
	11-49	28-38	1.30-1.50	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.28			
	49-72	20-30	1.20-1.50	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.43			
2C--------------- Higginsville	0-10	20-27	1.30-1.50	0.6-2.0	0.21-0.24	5.6-7.3	Low----------	0.37	5	6	3-4
	10-15	27-35	1.30-1.40	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.37			
	15-49	27-35	1.40-1.50	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.37			
	49-60	25-30	1.50-1.60	0.6-2.0	0.18-0.22	5.1-6.5	Moderate-----	0.37			
5C--------------- Macksburg	0-19	25-34	1.30-1.35	0.6-2.0	0.21-0.23	5.1-6.5	Moderate-----	0.32	5	7	3-4
	19-48	36-42	1.35-1.40	0.2-0.6	0.18-0.20	5.1-6.0	High---------	0.43			
	48-61	30-38	1.40-1.45	0.6-2.0	0.18-0.20	5.6-6.5	Moderate-----	0.43			
6B, 6C2, 6D2----- Sharpsburg	0-17	25-27	1.30-1.35	0.6-2.0	0.21-0.23	5.1-6.5	Moderate-----	0.32	5	6	3-4
	17-55	36-42	1.35-1.40	0.2-0.6	0.18-0.20	5.1-6.0	Moderate-----	0.43			
	55-60	25-32	1.40-1.45	0.6-2.0	0.18-0.20	6.1-6.5	Moderate-----	0.43			
8*. Pits											
9D, 9E----------- Snead	0-5	20-40	1.30-1.40	0.2-0.6	0.21-0.24	6.1-7.3	Moderate-----	0.37	3	6	2-4
	5-35	40-60	1.25-1.35	0.06-0.2	0.12-0.14	6.6-8.4	High---------	0.32			
	35-60	---	---	---	---	---	-------------	-----			
10D*, 10F*: Snead-----------	0-12	20-40	1.30-1.40	0.2-0.6	0.12-0.16	6.1-7.3	Moderate-----	0.28	3	6	2-4
	12-19	40-60	1.25-1.35	0.06-0.2	0.07-0.11	6.6-8.4	High---------	0.24			
	19-38	40-60	1.25-1.35	0.06-0.2	0.12-0.14	6.6-8.4	High---------	0.32			
	38-60	---	---	---	---	---	-------------	-----			
Rock outcrop.											
11C2------------- Greenton	0-11	27-40	1.30-1.45	0.2-0.6	0.12-0.18	5.6-6.5	Moderate-----	0.37	2	6	1-3
	11-49	35-50	1.35-1.50	0.06-0.2	0.11-0.15	5.6-7.3	High---------	0.37			
	49-60	40-50	1.35-1.50	0.06-0.2	0.08-0.12	6.6-7.8	High---------	0.37			
11C3, 11D3------- Greenton	0-6	27-40	1.30-1.45	0.2-0.6	0.12-0.18	5.6-6.5	Moderate-----	0.37	2	6	1-3
	6-37	35-50	1.35-1.50	0.06-0.2	0.11-0.15	5.6-7.3	High---------	0.37			
	37-60	40-50	1.35-1.50	0.06-0.2	0.08-0.12	6.6-7.8	High---------	0.37			
13B, 13C--------- Sampsel	0-15	25-35	1.30-1.50	0.2-0.6	0.21-0.24	5.6-7.3	Moderate-----	0.37	3-2	4	3-4
	15-60	35-60	1.40-1.60	0.06-0.2	0.11-0.13	5.6-7.8	High---------	0.37			
24B-------------- Lagonda	0-6	12-27	1.35-1.50	0.6-2.0	0.21-0.24	5.6-6.5	Moderate-----	0.37	3	6	2-4
	6-15	35-50	1.30-1.40	0.06-0.2	0.13-0.18	5.6-7.3	High---------	0.37			
	15-55	35-45	1.30-1.40	0.06-0.2	0.10-0.18	6.6-7.8	High---------	0.37			
	55-60	28-45	1.30-1.40	0.06-0.2	0.08-0.16	6.6-7.8	High---------	0.37			
25C2, 25D2------- Lagonda	0-9	27-32	1.35-1.50	0.2-0.6	0.18-0.20	5.6-6.5	Moderate-----	0.37	2	7	.5-2
	9-32	35-50	1.30-1.40	0.06-0.2	0.13-0.18	5.6-7.3	High---------	0.37			
	32-60	28-45	1.30-1.40	0.06-0.2	0.08-0.16	6.6-7.8	High---------	0.37			
26B-------------- Ladoga	0-11	18-35	1.30-1.35	0.6-2.0	0.22-0.24	6.1-7.3	Low----------	0.32	5	6	2-3
	11-46	36-42	1.30-1.40	0.2-0.6	0.18-0.20	5.1-6.0	Moderate-----	0.43			
	46-60	24-32	1.35-1.45	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.43			
26C2, 26D2------- Ladoga	0-11	18-35	1.30-1.35	0.6-2.0	0.22-0.24	6.1-7.3	Low----------	0.32	5	6	.5-1
	11-46	36-42	1.30-1.40	0.2-0.6	0.18-0.20	5.1-6.0	Moderate-----	0.43			
	46-60	24-32	1.35-1.45	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.43			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
27D3------------- Ladoga	0-4	18-35	1.30-1.35	0.6-2.0	0.22-0.24	6.1-7.3	Low-----------	0.32	5	6	.5-1
	4-41	36-42	1.30-1.40	0.2-0.6	0.18-0.20	5.1-6.0	Moderate-----	0.43			
	41-60	24-32	1.35-1.45	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.43			
31--------------- Colo	0-28	27-32	1.28-1.32	0.6-2.0	0.21-0.23	5.6-7.3	High---------	0.28	5	7	5-7
	28-48	30-35	1.25-1.35	0.6-2.0	0.18-0.20	5.6-7.3	High---------	0.28			
	48-60	25-35	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	High---------	0.28			
33--------------- Zook	0-37	32-38	1.30-1.35	0.2-0.6	0.21-0.23	5.6-7.3	High---------	0.28	5	7	5-7
	37-66	36-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.8	High---------	0.28			
35--------------- Booker	0-19	40-70	1.30-1.50	<0.06	0.12-0.14	5.6-7.3	Very high----	0.28	5	4	1-3
	19-60	60-75	1.30-1.50	<0.06	0.09-0.11	5.6-7.3	Very high----	0.28			
36--------------- Bremer	0-14	25-32	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7	5-7
	14-50	35-42	1.30-1.40	0.2-0.6	0.15-0.17	5.6-6.5	High---------	0.28			
	50-60	32-38	1.40-1.45	0.2-0.6	0.18-0.20	5.6-6.5	High---------	0.28			
37--------------- Moniteau	0-16	18-27	1.20-1.40	0.6-2.0	0.21-0.23	5.1-6.5	Low-----------	0.43	3	6	1-2
	16-64	27-35	1.30-1.50	0.2-0.6	0.18-0.20	4.5-6.0	Moderate-----	0.43			
38--------------- Wiota	0-12	24-32	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	6	3-4
	12-49	30-36	1.30-1.40	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.43			
	49-60	28-34	1.40-1.45	0.6-2.0	0.18-0.20	6.1-6.5	Moderate-----	0.43			
39--------------- Nodaway	0-60	18-28	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Moderate-----	0.37	5	6	2-3
41C2, 41D2------- Armster	0-6	15-27	1.35-1.50	0.6-2.0	0.17-0.20	4.5-7.3	Moderate-----	0.37	5	6	1-2
	6-41	35-48	1.35-1.45	0.2-0.6	0.10-0.18	4.5-7.3	High---------	0.37			
	41-60	28-40	1.30-1.40	0.2-0.6	0.10-0.15	6.6-7.8	Moderate-----	0.37			
42C3, 42E3------- Armster	0-5	27-40	1.35-1.45	0.2-0.6	0.10-0.18	4.5-7.3	Moderate-----	0.37	4	6	.5-1
	5-60	35-48	1.35-1.45	0.2-0.6	0.10-0.18	4.5-7.3	High---------	0.37			
54C2, 54E2, 54F-- Knox	0-7	18-27	1.20-1.30	0.6-2.0	0.22-0.24	5.6-7.3	Low-----------	0.32	5	6	1-3
	7-40	25-35	1.30-1.40	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43			
	40-60	18-27	1.20-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low-----------	0.43			
55D3------------- Knox	0-5	27-30	1.20-1.30	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.32	5	6	1-3
	5-58	25-35	1.30-1.40	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43			
	58-65	18-27	1.20-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low-----------	0.43			
56B-------------- Grundy	0-6	12-27	1.35-1.50	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.37	3	6	2-4
	6-15	32-45	1.35-1.45	0.2-0.6	0.18-0.20	5.6-6.5	High---------	0.37			
	15-36	40-50	1.30-1.40	0.06-0.2	0.11-0.13	5.1-7.3	High---------	0.37			
	36-60	28-35	1.35-1.40	0.06-0.2	0.18-0.20	5.6-7.3	High---------	0.37			
57C2------------- Grundy	0-8	28-35	1.35-1.45	0.2-0.6	0.18-0.20	5.6-7.3	High---------	0.37	3	6	2-4
	8-43	32-45	1.35-1.45	0.2-0.6	0.18-0.20	5.6-6.5	High---------	0.37			
	43-60	28-35	1.35-1.40	0.06-0.2	0.18-0.20	5.6-7.3	High---------	0.37			
61C*, 61D*, 61E*:											
Knox------------	0-7	18-27	1.20-1.30	0.6-2.0	0.22-0.24	5.6-7.3	Low-----------	0.32	5	6	1-3
	7-40	25-35	1.30-1.40	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43			
	40-60	18-27	1.20-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low-----------	0.43			
Urban land.											
68C*, 69A*. Urban land											
70B*, 70C*, 70D*:											
Sharpsburg------	0-17	25-27	1.30-1.35	0.6-2.0	0.21-0.23	5.1-6.5	Moderate-----	0.32	5	6	3-4
	17-55	36-42	1.35-1.40	0.2-0.6	0.18-0.20	5.1-6.0	Moderate-----	0.43			
	55-60	25-32	1.40-1.45	0.6-2.0	0.18-0.20	6.1-6.5	Moderate-----	0.43			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm^3	In/hr	In/in	pH					Pct
70B*, 70C*, 70D*: Urban land.											
71---------------- Aholt	0-46	60-80	1.20-1.30	<0.06	0.11-0.13	6.6-8.4	Very high----	0.28	5	4	2-4
	46-66	35-60	1.25-1.40	<0.06	0.11-0.15	6.6-8.4	High---------	0.28			
72---------------- Dockery	0-14	15-27	1.35-1.45	0.6-2.0	0.22-0.24	6.1-7.3	Low----------	0.37	5	6	2-4
	14-60	18-30	1.35-1.45	0.6-2.0	0.20-0.24	5.6-7.3	Moderate-----	0.37			
73---------------- Leta	0-14	40-48	1.30-1.50	0.06-0.2	0.12-0.14	6.6-7.8	High---------	0.28	5	4	2-4
	14-34	35-48	1.30-1.50	0.06-0.2	0.11-0.19	7.4-7.8	High---------	0.28			
	34-60	10-27	1.30-1.50	0.6-2.0	0.14-0.22	7.4-8.4	Low----------	0.28			
74---------------- Levasy	0-32	35-60	1.25-1.40	0.06-0.2	0.12-0.20	7.4-8.4	High---------	0.28	5	8	2-4
	32-60	12-27	1.35-1.50	0.6-2.0	0.10-0.18	7.4-8.4	Low----------	0.43			
75---------------- Norborne	0-17	8-12	1.20-1.40	0.6-2.0	0.20-0.24	5.6-7.3	Low----------	0.28	5	6	2-4
	17-45	12-18	1.20-1.40	0.6-2.0	0.17-0.22	5.6-7.3	Low----------	0.43			
	45-60	9-13	1.20-1.40	0.6-2.0	0.14-0.22	5.6-7.3	Low----------	0.43			
78---------------- Myrick	0-13	35-50	1.25-1.40	0.06-0.2	0.11-0.14	7.4-8.4	High---------	0.28	5	8	2-4
	13-60	5-18	1.35-1.50	0.6-2.0	0.15-0.19	7.4-8.4	Low----------	0.28			
80---------------- Landes	0-27	5-20	1.40-1.60	2.0-6.0	0.10-0.18	6.1-8.4	Low----------	0.20	5	3	1-2
	27-68	8-18	1.60-1.80	6.0-20	0.05-0.15	6.1-8.4	Low----------	0.20			
81---------------- Waldron	0-9	30-35	1.35-1.50	0.2-0.6	0.21-0.23	6.6-7.8	Moderate-----	0.32	5	7	2-4
	9-60	35-50	1.45-1.60	0.06-0.2	0.10-0.18	7.4-8.4	High---------	0.32			
82---------------- Parkville	0-19	40-70	1.30-1.50	<0.06	0.11-0.13	6.6-8.4	High---------	0.28	5	4	1-3
	19-72	4-25	1.40-1.60	0.6-2.0	0.18-0.22	7.4-8.4	Low----------	0.28			
83---------------- Haynie	0-9	15-25	1.20-1.35	0.6-2.0	0.18-0.23	7.4-8.4	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	Low----------	0.37			
87---------------- Modale	0-20	12-18	1.20-1.30	0.6-2.0	0.21-0.23	7.4-8.4	Moderate-----	0.37	5	4L	1-3
	20-60	50-60	1.35-1.45	<0.2	0.11-0.13	7.4-8.4	High---------	0.28			
88---------------- Gilliam	0-17	15-35	1.25-1.40	0.6-2.0	0.20-0.24	6.6-8.4	Moderate-----	0.28	5	4L	2-4
	17-51	15-35	1.30-1.45	0.6-2.0	0.17-0.22	7.4-8.4	Moderate-----	0.28			
	51-60	12-35	1.30-1.45	0.6-2.0	0.17-0.22	7.4-8.4	Moderate-----	0.28			
89---------------- Sarpy	0-6	2-5	1.20-1.50	>6.0	0.05-0.09	6.6-8.4	Low----------	0.15	5	2	<1
	6-60	2-5	1.20-1.50	>6.0	0.05-0.09	6.6-8.4	Low----------	0.15			
90---------------- Wabash	0-6	40-46	1.25-1.45	<0.06	0.12-0.14	5.6-7.3	Very high----	0.28	5	4	2-4
	6-66	40-60	1.20-1.45	<0.06	0.08-0.12	5.6-7.8	Very high----	0.28			
92---------------- Cotter	0-20	18-32	1.35-1.45	0.6-2.0	0.23-0.26	5.6-7.8	Moderate-----	0.32	5	7	3-4
	20-40	25-35	1.25-1.40	0.6-2.0	0.21-0.23	5.1-7.3	Moderate-----	0.43			
	40-60	18-27	1.30-1.45	0.6-2.0	0.20-0.22	5.1-7.3	Low----------	0.43			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern]

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				
1B, 1C------------ Sibley	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Low------	Moderate.
2C---------------- Higginsville	C	None---------	---	---	1.5-3.0	Perched	Nov-Apr	>60	---	High-----	Moderate	Moderate.
5C---------------- Macksburg	B	None---------	---	---	2.0-4.0	Apparent	Apr-Jul	>60	---	High-----	High-----	Moderate.
6B, 6C2, 6D2------ Sharpsburg	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
8*. Pits												
9D, 9E------------ Snead	D	None---------	---	---	2.0-3.0	Perched	Nov-Mar	20-40	Soft	Moderate	High-----	Low.
10D*, 10F*: Snead------------	D	None---------	---	---	2.0-3.0	Perched	Nov-Mar	20-40	Soft	Moderate	High-----	Low.
Rock outcrop.												
11C2, 11C3, 11D3-- Greenton	C	None---------	---	---	1.0-3.0	Perched	Nov-Apr	>60	---	Moderate	High-----	Moderate.
13B, 13C---------- Sampsel	D	None---------	---	---	0-1.5	Perched	Nov-Apr	40-70	Soft	High-----	High-----	Low.
24B, 25C2, 25D2--- Lagonda	C	None---------	---	---	1.5-3.0	Perched	Nov-Apr	>60	---	High-----	High-----	Low.
26B, 26C2, 26D2, 27D3------------- Ladoga	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
31---------------- Colo	B/D	Occasional	Very brief to long.	Nov-Jun	1.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
33---------------- Zook	C/D	Occasional	Brief to long.	Nov-Jun	1.0-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
35---------------- Booker	D	Occasional	Brief to long.	Nov-Jul	+.5-1.0	Perched	Nov-May	>60	---	Moderate	High-----	Moderate.
36---------------- Bremer	C	Occasional	Very brief	Nov-Jun	1.0-2.0	Apparent	Nov-Jul	>60	---	High-----	Moderate	Moderate.
37---------------- Moniteau	C/D	Rare---------	---	---	0-1.0	Perched	Nov-May	>60	---	High-----	High-----	High.

See footnote at end of table.

TABLE 17.--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				
38----------------- Wiota	B	Rare---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
39----------------- Nodaway	B	Occasional	Very brief to brief.	Nov-Jun	3.0-5.0	Apparent	Apr-Jul	>60	---	High-----	Moderate	Low.
41C2, 41D2, 42C3, 42E3------------- Armster	C	None---------	---	---	3.0-5.0	Apparent	Nov-Mar	>60	---	Moderate	High-----	Moderate.
54C2, 54E2, 54F, 55D3------------- Knox	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Low------	Low.
56B, 57C2--------- Grundy	C	None---------	---	---	1.0-3.0	Perched	Mar-May	>60	---	High-----	High-----	Moderate.
61C*, 61D*, 61E*: Knox--------------	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Low------	Low.
Urban land.												
68C*, 69A*. Urban land												
70B*, 70C*, 70D*: Sharpsburg-------	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
Urban land.												
71----------------- Aholt	D	Occasional	Brief-----	Nov-Jun	0-1.0	Apparent	Nov-Jun	>60	---	Moderate	High-----	Low.
72----------------- Dockery	C	Occasional	Brief-----	Nov-Jun	2.0-3.0	Apparent	Nov-Apr	>60	---	High-----	Moderate	Low.
73----------------- Leta	C	Occasional	Brief-----	Nov-Jun	1.0-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Low.
74----------------- Levasy	C	Occasional	Long------	Nov-Jun	+1-1.5	Apparent	Nov-Jun	>60	---	High-----	High-----	Low.
75----------------- Norborne	B	Rare---------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Low.
78----------------- Myrick	C	Occasional	Long------	Nov-Jun	+1-1.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Low.
80----------------- Landes	B	Occasional	Brief-----	Nov-Jun	4.0-6.0	Apparent	Mar-May	>60	---	Moderate	Low------	Low.
81----------------- Waldron	D	Occasional	Brief-----	Nov-Jun	1.0-3.0	Perched	Nov-May	>60	---	High-----	High-----	Low.

See footnote at end of table.

TABLE 17.--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				
82----------------- Parkville	C	Occasional	Brief-----	Nov-Jun	1.0-2.0	Apparent	Nov-Apr	>60	---	Moderate	High-----	Low.
83----------------- Haynie	B	Occasional	Very brief	Feb-Nov	>6.0	---	---	>60	---	High-----	Low------	Low.
87----------------- Modale	C	Occasional	Brief-----	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
88----------------- Gilliam	C	Occasional	Brief-----	Mar-Jun	1.5-3.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Low.
89----------------- Sarpy	A	Occasional	Brief to long.	Nov-Jun	>6.0	---	---	>60	---	Low------	Low------	Low.
90----------------- Wabash	D	Occasional	Brief to long.	Nov-May	0-1.0	Apparent	Nov-May	>60	---	Moderate	High-----	Moderate.
92----------------- Cotter	B	Rare---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Aholt	Very fine, montmorillonitic (calcareous), mesic Vertic Haplaquolls
Armster	Fine, montmorillonitic, mesic Mollic Hapludalfs
Booker	Very fine, montmorillonitic, mesic Vertic Haplaquolls
Bremer	Fine, montmorillonitic, mesic Typic Argiaquolls
Colo	Fine-silty, mixed, mesic Cumulic Haplaquolls
Cotter	Fine-silty, mixed, mesic Typic Argiudolls
Dockery	Fine-silty, mixed, nonacid, mesic Aquic Udifluvents
Gilliam	Fine-silty, mixed, mesic Fluvaquentic Hapludolls
Greenton	Fine, montmorillonitic, mesic Aquic Argiudolls
Grundy	Fine, montmorillonitic, mesic Aquic Argiudolls
Haynie	Coarse-silty, mixed (calcareous), mesic Mollic Udifluvents
Higginsville	Fine-silty, mixed, mesic Aquic Argiudolls
Knox	Fine-silty, mixed, mesic Mollic Hapludalfs
Ladoga	Fine, montmorillonitic, mesic Mollic Hapludalfs
Lagonda	Fine, montmorillonitic, mesic Aquic Argiudolls
Landes	Coarse-loamy, mixed, mesic Fluventic Hapludolls
Leta	Clayey over loamy, montmorillonitic, mesic Fluvaquentic Hapludolls
Levasy	Clayey over loamy, montmorillonitic (calcareous), mesic Fluvaquentic Haplaquolls
Macksburg	Fine, montmorillonitic, mesic Aquic Argiudolls
Modale	Coarse-silty over clayey, mixed (calcareous), mesic Aquic Udifluvents
Moniteau	Fine-silty, mixed, mesic Typic Ochraqualfs
Myrick	Clayey over loamy, montmorillonitic (calcareous), mesic Fluvaquentic Haplaquolls
Nodaway	Fine-silty, mixed, nonacid, mesic Mollic Udifluvents
Norborne	Coarse-loamy, mixed, mesic Typic Argiudolls
Parkville	Clayey over loamy, montmorillonitic, mesic Fluvaquentic Hapludolls
Sampsel	Fine, montmorillonitic, mesic, sloping Typic Argiaquolls
Sarpy	Mixed, mesic Typic Udipsamments
Sharpsburg	Fine, montmorillonitic, mesic Typic Argiudolls
Sibley	Fine-silty, mixed, mesic Typic Argiudolls
Snead	Fine, mixed, mesic Aquic Hapludolls
Wabash	Fine, montmorillonitic, mesic Vertic Haplaquolls
Waldron	Fine, montmorillonitic (calcareous), mesic Aeric Fluvaquents
Wiota	Fine-silty, mixed, mesic Typic Argiudolls
Zook	Fine, montmorillonitic, mesic Cumulic Haplaquolls

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