United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with
Iowa Agriculture and
Home Economics
Experiment Station;
Cooperative Extension
Service, Iowa State
University; and Division of
Soil Conservation, Iowa
Department of Agriculture
and Land Stewardship

Soil Survey of Clarke County, Iowa

This CD contains a historical replica of the soil survey of Clark County, Iowa. This soil survey was first issued in 1989. Since that time, many of the tables have been updated. To access the official tables for this survey, please access Section II of the electronic Field Office Technical Guide at: http://www.ia.nrcs.usda.gov/.

How To Use This Soil Survey

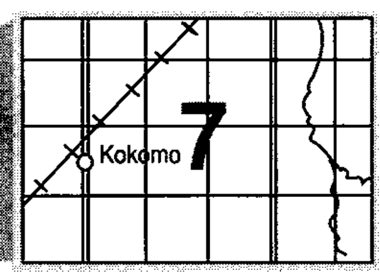
General Soil Map

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

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

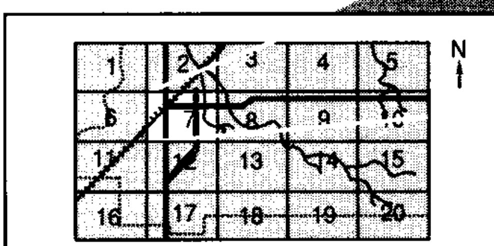
Detailed Soil Maps

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



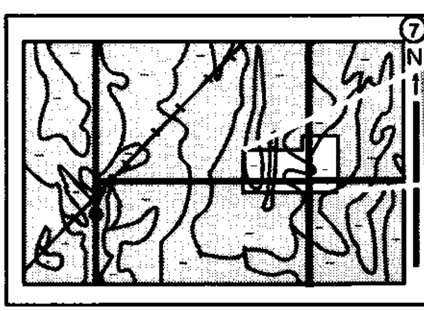
MAP SHEET

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



INDEX TO MAP SHEETS

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



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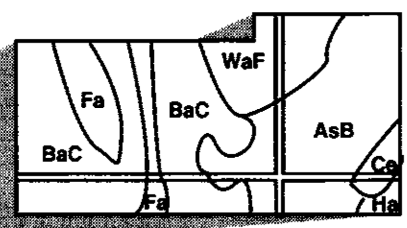

AREA OF INTEREST

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

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

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

Major fieldwork for this soil survey was completed in 1986. Soil names and descriptions were approved in 1987. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1986. This survey was made cooperatively by the Soil Conservation Service; the Iowa Agriculture and Home Economics Experiment Station; the Cooperative Extension Service, Iowa State University; and the Division of Soil Conservation, Iowa Department of Agriculture and Land Stewardship. It is part of the technical assistance furnished to the Clarke County Soil and Water Conservation District. Funds appropriated by Clarke County were used to defray part of the cost of the survey.

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: Soybeans on Lawson silt loam, 0 to 2 percent slopes. The Gara and Armstrong soils are in the background.

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Issued July 1989

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Summary of Tables

Preface

This soil survey contains information that can be used in land-planning programs in Clarke County, Iowa. 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.

Soil Survey of Clarke County, Iowa

By Asghar A. Chowdhery, Soil Conservation Service

Fieldwork by Asghar A. Chowdhery and Stephen J. Ernst, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service,
in cooperation with
the Iowa Agriculture and Home Economics Experiment Station; the Cooperative Extension Service, Iowa State University; and the Division of Soil Conservation, Iowa Department of Agriculture and Land Stewardship

CLARKE COUNTY is in the south-central part of Iowa (fig. 1). Its area is 274,496 acres, or about 429 square miles. Osceola, its county seat, is in the central part of the county. It is about 46 miles south of Des Moines, the state capital.

Most of the acreage in the county is farmland used mainly for corn, soybeans, oats, hay, or pasture. A small acreage, mainly around Whitebreast Creek, Squaw Creek, and South River, is woodland. Corn and soybeans are the main grain crops. Raising livestock, principally hogs and cow-calf herds, is an important enterprise.

This survey updates the soil survey of Clarke County published in 1928 *(15)*. It provides additional information and larger maps, which show the soils in greater detail.

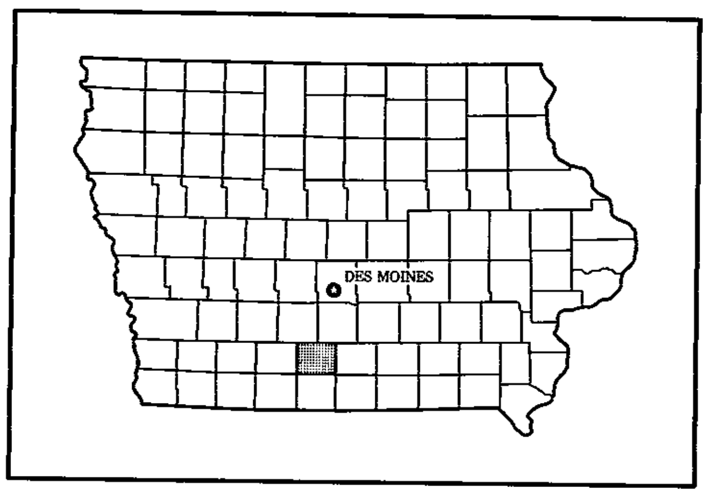

Figure 1.—Location of Clarke County in Iowa.

General Nature of the County

The paragraphs that follow provide general information about Clarke County. They describe the history and development of the county; transportation facilities, industry, and recreation; relief; drainage; agriculture; and climate.

History and Development

At the time of the Louisiana Purchase of 1803, the region now called Clarke County was in possession of the Sac, Fox, Sioux, and Potawatomi Indians. During this time, it was nominally a part of Des Moines County. In 1846, by an act of the Territorial Legislature, it was established as a county, and was named in honor of James Clarke, then Governor of the Territory *(7)*. It then lacked its present easternmost tier of townships, but included the eastern half of the present Union County, making it five townships long and three townships wide. The present boundaries were established in 1849.

The first white settlers in the county were four families of Mormons. They became separated from the main group, and stopped to winter at a place called "Lost Camp" in the fall of 1847. This place is in the present Green Bay Township. Within 3 years, however, all four families continued their journey westward to Salt Lake City, Utah.

The first permanent settlement in Clarke County was located in Franklin Township in the spring of 1850. More settlement took place in Liberty Township and in Green Bay Township in May 1850. Pioneers that arrived in 1851 settled in most townships.

The legislature of 1850-51 ordered the organization of the county. The first election was held in August 1851, and Osceola was established as the county seat of Clarke County. The population of Clarke County had reached 5,427, and 650 persons lived in Osceola. Soon after the completion of the Burlington and Missouri River Railroad in 1868, many settlers came to Clarke County by train from the East. The population of the county grew to 8,735 by 1870. The 1880 census reported the county population as 11,513. In 1900, the population increased to an all-time high of 12,440. The 1980 census showed the Clarke County population at 8,612, of which 3,750 persons lived in Osceola.

Transportation Facilities, Industry, and Recreation

Three major highways serve the county. Interstate 35 traverses the county north and south, and U.S. Highway 34 runs east and west. They intersect each other at the western edge of Osceola. U.S. Highway 69 runs dominantly north and south, and intersects U.S. Highway 34 at the center of Osceola. Hard-surface county roads connect the major highways to all of the smaller communities in the county. All farmsteads are along farm-to-market roads of gravel or crushed limestone. The major county roads are well distributed throughout the county. Motor freight carriers serve every trading center in the county.

Burlington Northern double track railroad traverses the county from east to west through Woodburn, Osceola, and Murray. With service to both the East Coast and the West Coast, Amtrak passenger trains stop at Osceola twice a day. A bus line provides north and south transportation from Osceola. A municipal airport, 3 miles northeast of Osceola, has a paved runway 4,000 feet long and 150 feet wide.

The county is mainly rural, but has several small industries. These industries make pork sausage, pressure switches and contactors, dairy equipment, and automobile wiring products. Osceola has two grain elevators for rail shipment of grain.

Several county parks are located throughout Clarke County. Every town has at least one local park. Clarke County supports many kinds of wildlife that contribute to its recreation and to its economy. Game, including white-tailed deer, wild turkey, pheasant, and quail, is very plentiful. Fishing is good in the county lakes and farm ponds.

Relief

Clarke County is part of an extensive glacial drift plain mantled with loess. The landscape has been modified and altered by the action of streams, and has the characteristic broken appearance of the south-central part of Iowa.

Relief ranges from nearly level to very steep. The topography is characterized by rolling to very steep valleys along streams and major drainageways. It is nearly level and gently rolling on upland divides, which have retained much of the original surface character. It also consists of narrow strips of nearly level bottom land that borders most creeks and streams. Along the major drainageways the valley bottoms are 90 to 150 feet lower than the top of the adjacent upland divides. In many places, the south and west slopes are typically abrupt and steep. The valley north- and east-facing slopes are longer and less steep.

One of the prominent divides that separates the Des Moines River Watershed from the Missouri River Watershed was part of the Mormon Trail used by pioneers journeying east to west through Clarke County.

The highest elevation in Clarke County, about 1,221 feet, is 1 mile north of Murray. The lowest elevation, about 891 feet, is 1 mile south of the northwest corner of the county where Otter Creek exits the county.

Drainage

Clarke County is drained by the tributaries of the Des Moines and Missouri Rivers. About 70 percent of the county is drained into the Des Moines River, and 30 percent is drained into the Missouri River. The tributaries of the Des Moines River include Otter Creek, South River, Squaw Creek, and Whitebreast Creek, and drain the northeast, northwest, north-central, and east-central parts of the county, respectively. These tributaries flow northeast into the Des Moines River. The tributaries of the Missouri River, including Bee Creek, Chariton Creek, Long Creek, and Sevenmile Creek, drain the south-central, southwestern, and southeastern parts of the county. Bee Creek, Long Creek, and Sevenmile Creek flow south, and eventually flow into the Missouri River. Chariton Creek flows east into the Chariton River, which eventually flows into the Missouri River.

In most parts of Clarke County, natural drainage is adequate. In some parts, however, artificial drainage is needed in nearly level areas of upland divides.

Agriculture

A recent trend in the county has been a gradual decrease in the number of farms and an increase in the average size of the farms. In 1985, 740 farms were in the county and the average farm size was 357 acres *(4)*.

Agriculture in the county centers on grain crop production and mixed livestock. In 1985, corn was planted on about 50,000 acres. It was harvested for grain on 48,000 acres and for silage on 2,000 acres. The average corn grain yield was 130.4 bushels per acre. Soybeans were grown on about 32,100 acres. Of this acreage, 31,900 acres of soybeans was harvested for grain. The average soybean yield was 38.3 bushels per acre. Hay and oats were grown on about 25,300 and 8,000 acres, respectively *(4)*.

In 1985, about 84,000 hogs were marketed. About 46,500 cows and calves were on farms, and 2,500 grain-fed beef cattle were marketed. Milk cows on farms numbered about 400. About 1,500 sheep and lambs were on farms, and 1,200 of them were marketed *(4)*.

Climate

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

Clarke County is cold in winter, and is quite hot and has occasional cool spells in summer. Precipitation in winter frequently occurs as snowstorms. During the warm months it is chiefly showers, often heavy, when warm, moist air moves in from the south. Total annual rainfall is normally adequate for corn, soybeans, and small grains.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Osceola in the period 1951 to 1984. 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 25 degrees F, and the average daily minimum temperature is 15 degrees. The lowest temperature on record, which occurred at Osceola on January 10, 1982, is -28 degrees. In summer the average temperature is 73 degrees, and the average daily maximum temperature is 85 degrees. The highest recorded temperature, which occurred on July 21, 1974, is 106 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 35 inches. Of this, 24 inches, or about 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 20 inches. The heaviest 1-day rainfall during the period of record was 6.20 inches at Osceola on November 17, 1952. Thunderstorms occur on about 50 days each year, and most occur in summer.

Tornadoes and severe thunderstorms strike occasionally. These storms are local in extent and of short duration. They result in sparse damage in narrow belts. Hailstorms occur at times during the warmer part of the year in irregular patterns and in relatively small areas.

The average seasonal snowfall is about 31 inches. The greatest snow depth at any one time during the period of record was 24 inches. On the average, 25 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 70 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the northwest. Average windspeed is highest, 13 miles per hour, in spring.

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

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

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

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

Map Unit Composition

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

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

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

General Soil Map Units

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

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

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

Soil Descriptions

1. Shelby-Lamoni-Arispe Association

Moderately sloping to steep, moderately well drained and somewhat poorly drained, loamy and silty soils formed in glacial till, in a paleosol weathered from glacial till, and in loess; on uplands

This association consists of soils on long and narrow, convex ridgetops and on short, convex shoulder slopes, nose slopes, and valley side slopes. In most areas the landscape is gently rolling to steep and slopes range from 5 to 25 percent.

This association makes up about 26 percent of the county. It is about 33 percent Shelby soils, 30 percent Lamoni and similar soils, 17 percent Arispe soils, and 20 percent minor soils (fig. 2).

Shelby soils are strongly sloping to steep, and are on valley side slopes and nose slopes. They formed in glacial till, and are moderately well drained. Lamoni soils are moderately sloping and strongly sloping, and are on narrow ridgetops, shoulder slopes, nose slopes, and side slopes. They formed in a thin mantle of sediments or loess and in the underlying, partly truncated paleosol weathered from glacial till, and are somewhat poorly drained. Arispe soils are moderately sloping, and are on narrow convex ridgetops, shoulder slopes, and short, convex side slopes. They formed in loess and are somewhat poorly drained. All three soils formed under native vegetation of prairie grasses.

Typically, the surface layer of the Shelby soils is very dark brown, friable clay loam about 8 inches thick. It is mixed with streaks and pockets of dark yellowish brown subsoil material. The subsoil to a depth of about 60 inches is mottled, firm clay loam. In the upper part it is dark yellowish brown. In the next part it is dark yellowish brown and yellowish brown. In the lower part it is yellowish brown. Pebbles and stones are throughout the profile, and a few of these are scattered on the surface.

Typically, the surface layer of the Lamoni soils is black, friable clay loam about 10 inches thick. The subsurface layer is very dark gray and very dark grayish brown, friable clay loam about 4 inches thick. The subsoil is about 38 inches thick, and is mottled. In the upper part it is dark grayish brown, firm clay loam. In the next part it is grayish brown, yellowish brown, and light gray, very firm clay. In the lower part it is yellowish brown and light gray, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown and light gray, mottled, friable clay loam.

Typically, the surface layer of the Arispe soils is black, friable silty clay loam about 9 inches thick. The subsurface layer is very dark gray, firm silty clay loam about 4 inches thick. The subsoil is about 40 inches thick, and is mottled. In the upper part it is dark grayish brown, firm silty clay loam. In the next part it is dark grayish brown and grayish brown, firm silty clay. In the lower part it is grayish brown and light brownish gray, firm and friable silty clay loam. The substratum to a depth of about 60 inches is light olive gray, mottled, friable silty clay loam.

The minor soils in this association are the Clarinda,

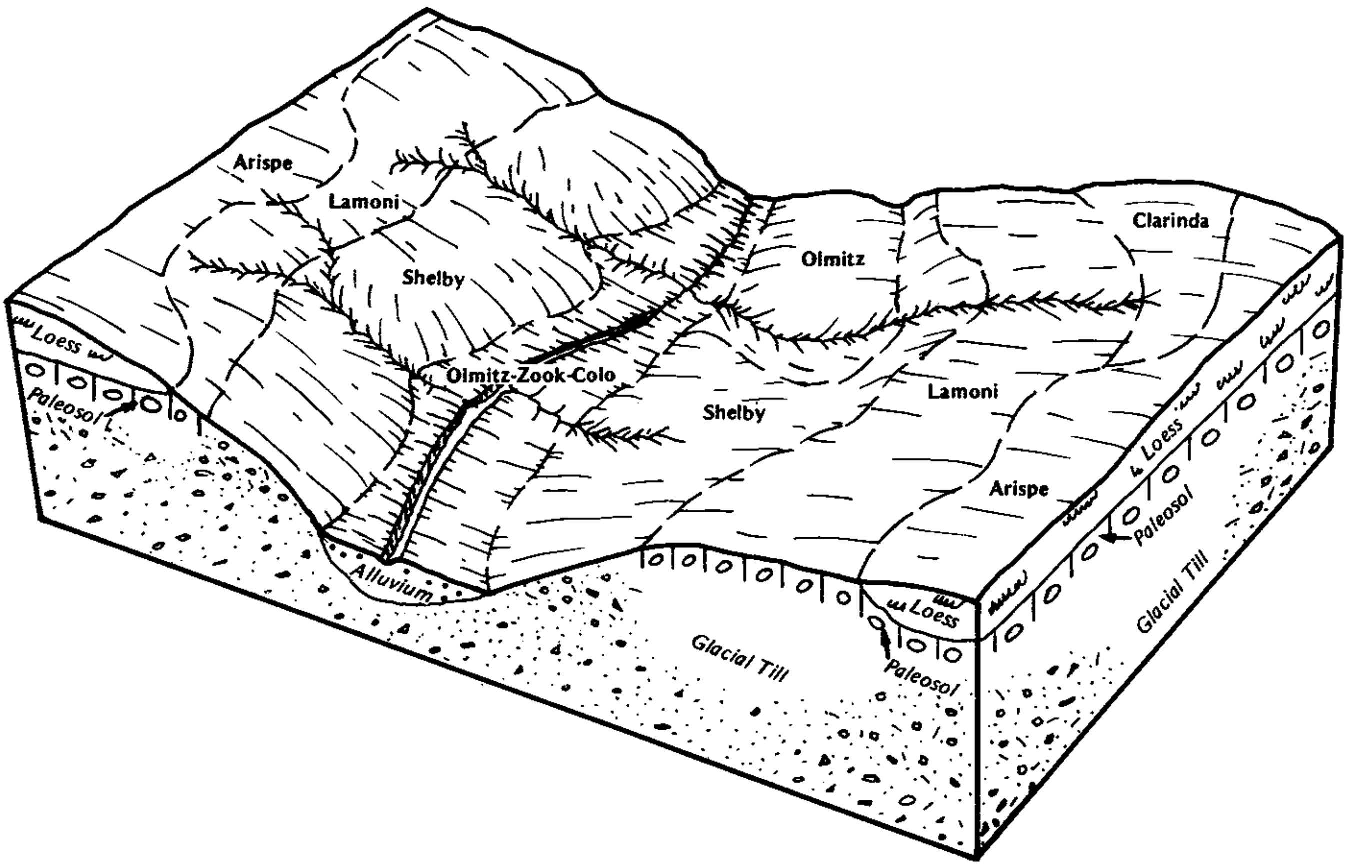

Figure 2.—Typical pattern of soils and underlying material in the Shelby-Lamoni-Arispe association.

Colo, Olmitz, and Zook soils. Clarinda soils are poorly drained and very slowly permeable. They formed in a thin mantle of loess and in an underlying, exhumed, gray, clayey paleosol on short, convex side slopes and in coves at the heads of drainageways on uplands. Colo and Zook soils are poorly drained, formed in silty alluvium on bottom land along drainageways, and have a thick, dark colored surface soil. Olmitz soils formed in loamy alluvium on foot slopes adjacent to the Shelby soils, and have a thick, dark colored surface soil.

This association is used mainly for hay and pasture. In most areas it is moderately well suited and well suited to grasses and legumes for hay and pasture. The gently sloping and moderately sloping upland soils are used for cultivated crops. They are well suited and moderately well suited to corn, soybeans, and small grains. The soils on bottom land are used for cultivated crops, hay, or permanent pasture, depending on the width of the bottom land and the number of stream channel meanders. Hogs, cow-calf herds, and cash-grain crops are the major commodities. The main concerns of management are controlling water erosion, preventing the formation of gullies, and maintaining or improving fertility and tilth. The major concerns in pasture management are overgrazing and grazing when the soils are wet, both of which cause erosion. A system of conservation tillage that leaves crop residue on the surface, contour farming, a cropping rotation that includes grasses and legumes, and terraces help to prevent excessive soil loss.

2. Gara-Armstrong-Pershing Association

Gently sloping to steep, moderately well drained and somewhat poorly drained, loamy and silty soils formed in glacial till, in loess or sediments overlying a paleosol, and in loess; on uplands

This association consists of soils on long and narrow, convex ridgetops, short, convex shoulder slopes, nose slopes, and valley side slopes. The side slopes are dissected by many small drainageways. Scattered trees grow in the drainageways and along some fences. Trees also grow in a few small, irregularly shaped areas. In most areas, the landscape is undulating to steep and slopes range from 2 to 25 percent.

This association makes up about 22 percent of the county. It is about 36 percent Gara soils, 28 percent Armstrong soils, 22 percent Pershing soils, and 14 percent minor soils (fig. 3).

Gara soils are strongly sloping to steep and on valley side slopes and nose slopes. They formed in glacial till, and are moderately well drained. Armstrong soils are moderately sloping and strongly sloping, and on narrow, convex ridgetops, shoulder slopes, nose slopes, and valley side slopes. They formed in a thin mantle of sediments or loess and in the underlying paleosol weathered from glacial till, and are moderately well drained and somewhat poorly drained. Pershing soils are gently sloping and moderately sloping, and on long and narrow, convex ridgetops and short, convex upper side slopes. They formed in loess and are moderately well drained and somewhat poorly drained. All three soils formed under native vegetation of mixed prairie grasses and deciduous trees.

Typically, the surface layer of the Gara soils is very dark gray, friable loam about 7 inches thick. The subsurface layer is dark grayish brown and yellowish brown, friable loam about 3 inches thick. The subsoil extends to a depth of about 60 inches, and is mottled. In the upper part it is yellowish brown, friable clay loam. In the next part it is dark yellowish brown and yellowish brown, very firm clay. In the lower part it is yellowish

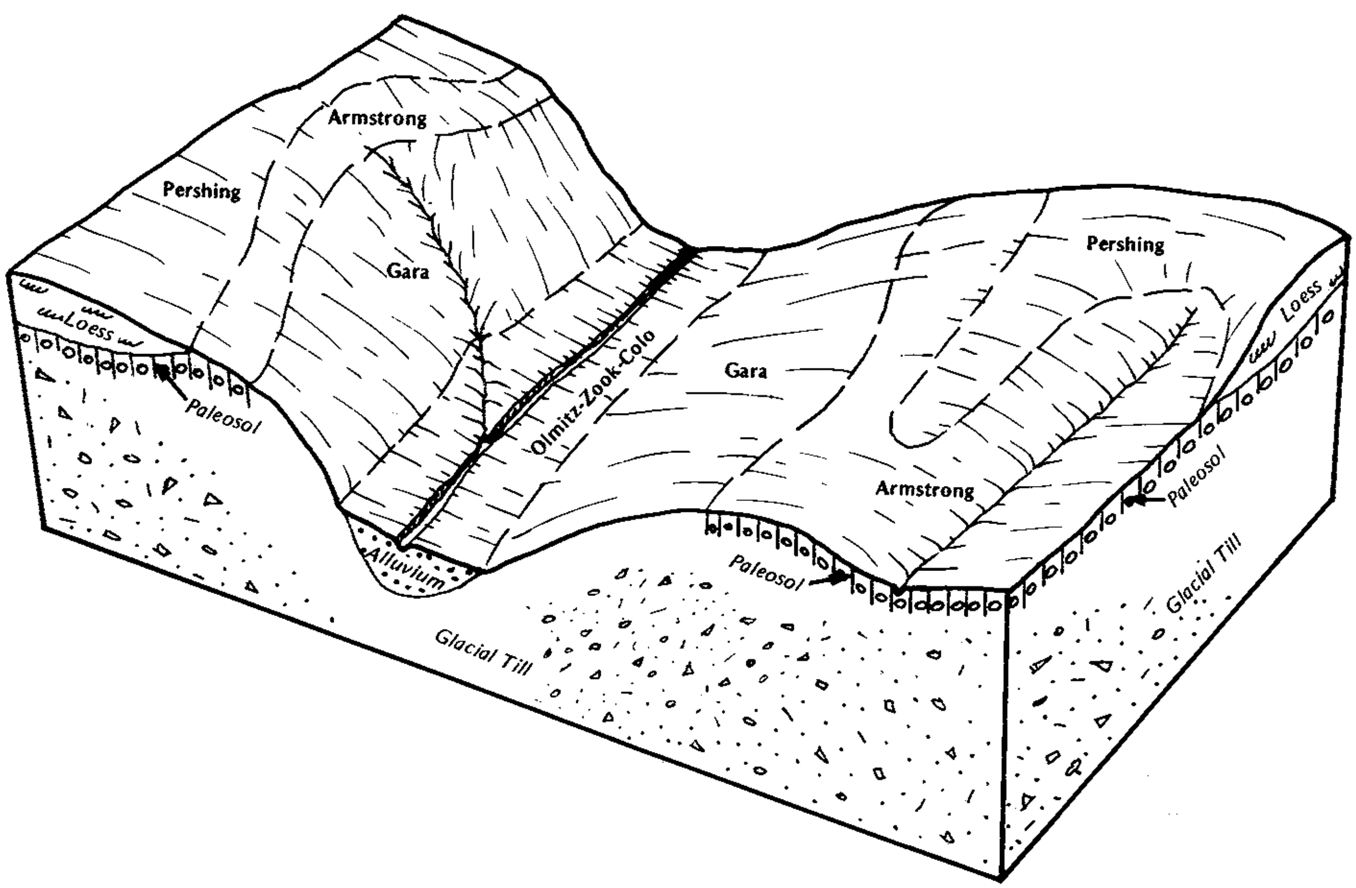

Figure 3.—Typical pattern of soils and underlying material in the Gara-Armstrong-Pershing association.

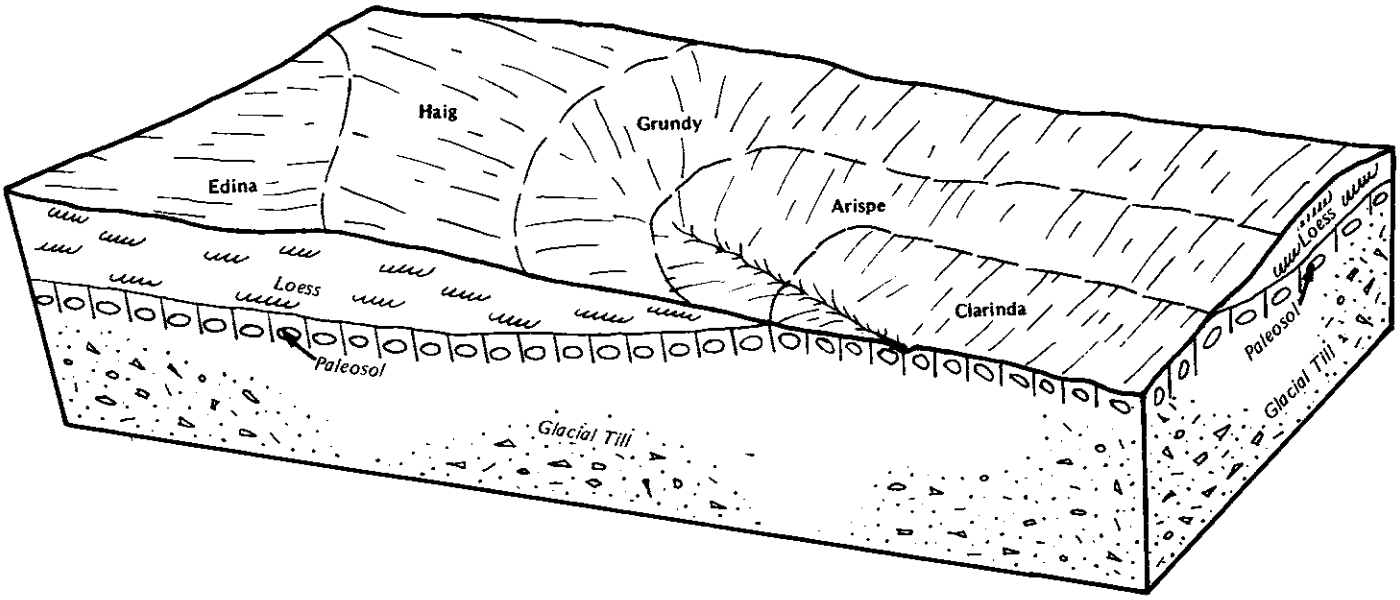

Figure 4.—Typical pattern of soils and underlying material in the Grundy-Haig-Arispe association.

brown, firm, calcareous clay loam and has accumulations of lime. Stones and pebbles are in the subsoil.

Typically, the surface layer of the Armstrong soils is very dark gray and very dark grayish brown, friable loam or clay loam about 7 inches thick. The subsurface layer is dark grayish brown and yellowish brown, mottled, friable loam about 5 inches thick. The subsoil extends to a depth of about 60 inches, and is mottled. In the upper part it is brown and strong brown, very firm clay. In the lower part it is yellowish brown, firm clay loam.

Typically, the surface layer of the Pershing soils is very dark grayish brown, friable silt loam about 8 inches thick. The subsurface layer is brown, friable silt loam about 5 inches thick. The subsoil extends to a depth of about 60 inches. In the upper part it is yellowish brown, friable silty clay loam. In the next part it is grayish brown and yellowish brown, mottled, very firm and firm silty clay. In the lower part it is grayish brown and light brownish gray, mottled, firm and friable silty clay loam.

The minor soils in this association are the Bucknell, Caleb, Colo, Mystic, Olmitz, and Zook soils. Bucknell soils formed in a thin mantle of sediments or loess and in the underlying, partly truncated, clayey paleosol that weathered from glacial till. They are in the upland coves and side slopes upslope from Gara and Armstrong soils. Caleb and Mystic soils formed in weathered alluvial sediments derived from glacial till on high terraces adjacent to major streams. Colo and Zook soils are poorly drained, and formed in silty alluvium on bottom land along drainageways. They have a thick, dark colored surface soil. Olmitz soils formed in loamy alluvium on foot slopes adjacent to Gara soils, and have a thick, dark colored surface soil.

This association is used mainly for permanent pastures and hay. In most areas it is moderately well suited to grasses and to legumes for hay and pasture. Many ponds are in the steep areas. They help to control water erosion, to prevent gully formation, and to provide water for livestock. Most of the gently sloping and moderately sloping areas are used for cultivated crops. They are moderately well suited to row crops and well suited to small grains and to grasses and legumes for hay and pasture. Cow-calf herds, hogs and sheep, and cash-grain crops are the major commodities. The main concerns of management are controlling water erosion, preventing the formation of gullies, and maintaining or improving fertility and tilth. The major concerns in pasture management are overgrazing and grazing when the soils are wet, both of which cause erosion. A system of conservation tillage that leaves crop residue on the surface, contour farming, a cropping rotation that includes grasses and legumes, and terraces help to prevent excessive soil loss.

3. Grundy-Haig-Arispe Association

Nearly level to moderately sloping, somewhat poorly drained and poorly drained, silty soils formed in loess; on uplands

This association consists of soils on broad flats and on long and narrow, convex ridgetops and side slopes. In most areas the landscape is nearly level to gently rolling. Slopes range from 0 to 9 percent.

This association makes up about 20 percent of the county. It is about 31 percent Grundy soils, 24 percent Haig soils, 21 percent Arispe soils, and 24 percent minor soils (fig. 4).

Grundy soils are gently sloping and on moderately wide ridgetops and short, convex, upper side slopes. They are somewhat poorly drained. Haig soils are nearly level and on broad flats, and are poorly drained. Arispe soils are moderately sloping and on narrow, convex ridgetops and short, convex side slopes, and are somewhat poorly drained. All three soils formed under native vegetation of prairie grasses.

Typically, the surface layer of the Grundy soils is black, friable silty clay loam about 9 inches thick. The subsurface layer is black and very dark gray, friable silty clay loam about 6 inches thick. The subsoil is about 38 inches thick, and is mottled. In the upper part it is dark grayish brown and grayish brown, firm silty clay. In the next part it is grayish brown, firm silty clay loam. In the lower part it is olive gray, friable silty clay loam. The substratum to a depth of about 60 inches is light olive gray, mottled, friable silty clay loam.

Typically, the surface layer of the Haig soils is black, friable silt loam about 7 inches thick. The subsurface layer is black, friable silty clay loam about 8 inches thick. The subsoil extends to a depth of about 60 inches, and is mottled. In the upper part it is very dark gray and dark gray, firm and very firm silty clay loam and silty clay. In the next part it is olive gray, firm silty clay. In the lower part it is light olive gray, firm and friable silty clay loam.

Typically, the surface layer of the Arispe soils is black, friable silty clay loam about 8 inches thick. It is mixed with streaks and pockets of dark grayish brown subsoil material. The subsoil is about 37 inches thick, and is mottled. In the upper part it is dark grayish brown and grayish brown, firm silty clay. In the next part it is grayish brown, firm silty clay loam. In the lower part it is light brownish gray, friable silty clay loam. The substratum to a depth of about 60 inches is light brownish gray, mottled, friable silty clay loam. In some places, the surface layer and subsurface layer are black and very dark gray, friable silty clay loam 10 inches thick or more.

The minor soils in this association are the Clarinda, Colo, Edina, Lamoni, and Zook soils. Clarinda soils are very slowly permeable, and formed in a thin mantle of loess and in the underlying, exhumed, gray, clayey paleosol on short, convex side slopes and in coves at the heads of drainageways on uplands. Edina soils are very slowly permeable, and are in shallow depressions on broad, upland flats. Colo and Zook soils formed in silty alluvium on bottom land along the drainageways. They have a thick, dark colored surface soil. Lamoni soils formed in a thin mantle of sediments or loess and in the underlying, partly truncated paleosol weathered from glacial till.

This association is used mainly for cultivated crops. In nearly level and gently sloping areas, it is well suited to corn, soybeans, and small grains and to grasses and legumes for hay. The moderately sloping areas are moderately well suited to row crops and well suited to small grains and to grasses and legumes for hay and pasture. Cash-grain crops and livestock are the major commodities. The main concerns of management are controlling water erosion, improving drainage, and maintaining or improving fertility and tilth. Erosion is a severe hazard if row crops are grown in moderately sloping areas. In the nearly level areas surface and subsurface drainage is needed for maximum row crop production. A system of conservation tillage that leaves crop residue on the surface, contour farming, a cropping rotation that includes grasses and legumes, and terraces help to prevent excessive soil loss.

4. Shelby-Lamoni-Sharpsburg Association

Gently sloping to steep, moderately well drained and somewhat poorly drained, loamy and silty soils formed in glacial till, in a paleosol weathered from glacial till, and in loess; on uplands

This association consists of soils on long and narrow, convex ridgetops and short, convex shoulder slopes, nose slopes, and valley side slopes. In most areas the landscape is undulating to steep. Slopes range from 2 to 25 percent.

This association makes up about 10 percent of the county. It is about 32 percent Shelby soils, 26 percent Lamoni and similar soils, 16 percent Sharpsburg and similar soils, and 26 percent minor soils.

The Shelby soils are strongly sloping to steep, and on valley side slopes and nose slopes. They formed in glacial till, and are moderately well drained. The Lamoni soils are moderately sloping and strongly sloping, and on narrow ridgetops, shoulder slopes, nose slopes, and side slopes. They formed in a thin mantle of sediments or loess and in the underlying, partly truncated paleosol weathered from glacial till, and are somewhat poorly drained. The Sharpsburg soils are gently sloping and moderately sloping, and on long and narrow, convex ridgetops, shoulder slopes, and side slopes. They formed in loess, and are moderately well drained. All three soils formed under native vegetation of prairie grasses.

Typically, the surface layer of the Shelby soils is very dark brown, friable clay loam about 8 inches thick. It is mixed with streaks and pockets of brown subsoil material. The subsoil is mottled, firm clay loam about 36 inches thick. In the upper part it is brown and dark yellowish brown. In the next part it is dark yellowish brown and yellowish brown. In the lower part it is yellowish brown and light brownish gray. The substratum to a depth of about 60 inches is yellowish brown and light brownish gray, mottled, firm, calcareous clay loam. Stones and pebbles are in the subsoil and substratum.

Typically, the surface layer of the Lamoni soils is very dark gray, friable clay loam about 7 inches thick. It is mixed with streaks and pockets of dark grayish brown subsoil material. The subsoil extends to a depth of about 60 inches, and is mottled. In the upper part it is dark grayish brown, firm clay loam. In the next part it is grayish brown, gray, and yellowish brown, very firm clay. In the lower part it is yellowish brown and light gray, firm clay loam.

Typically, the surface layer of the Sharpsburg soils is very dark brown, friable silty clay loam about 9 inches thick. The subsurface layer is very dark brown and dark brown, friable silty clay loam about 7 inches thick. The subsoil is about 35 inches thick. In the upper part it is brown, friable silty clay loam. In the next part it is dark yellowish brown, mottled, firm silty clay loam. In the lower part it is grayish brown and light brownish gray, mottled, friable silty clay loam. The substratum to a depth of about 60 inches is light brownish gray, mottled, friable silty clay loam.

The minor soils in this association are the Clarinda, Colo, Macksburg, Olmitz, and Zook soils. Clarinda soils are poorly drained and very slowly permeable. They formed in a thin mantle of loess and in the underlying, exhumed, gray, clayey paleosol on short, convex side slopes and in coves at the heads of drainageways on uplands. Macksburg soils are gently sloping and on the moderately wide ridgetops. They formed in loess. Olmitz soils formed in loamy alluvium on foot slopes adjacent to the Shelby soils, and have a thick, dark colored surface soil. Colo and Zook soils formed in silty alluvium on bottom land along the drainageways. They are poorly drained, and have a thick, dark colored surface soil.

This association is used mainly for hay and pasture. In most areas it is moderately well suited and well suited to grasses and legumes for hay and pasture. The gently sloping and moderately sloping soils are used for cultivated crops. They are well suited and moderately well suited to corn, soybeans, and small grains. The soils on bottom land are used for cultivated crops, hay, and permanent pasture, depending on the width of the bottom land and the number of stream channel meanders. Hogs, cow-calf herds, and cash-grain crops are the major commodities. The main concerns of management are controlling water erosion, preventing the formation of gullies, and maintaining or improving fertility and tilth. The major concerns in pasture management are overgrazing and grazing when the soils are wet, both of which cause erosion. A system of conservation tillage that leaves crop residue on the surface, contour farming, a cropping rotation that includes grasses and legumes, and terraces help to prevent excessive soil loss.

5. Gara-Armstrong-Sharpsburg Association

Gently sloping to steep, moderately well drained and somewhat poorly drained, loamy and silty soils formed in glacial till, in loess or sediments overlying a paleosol, and in loess; on uplands

This association consists of soils on long and narrow, convex ridgetops and short, convex shoulder slopes, nose slopes, and valley side slopes. Side slopes are dissected by many small drainageways. Scattered trees grow in the drainageways and along some fences. In most areas the landscape is undulating to steep. Slopes range from 2 to 25 percent.

This association makes up about 9 percent of the county. It is about 34 percent Gara soils, 23 percent Armstrong soils, 13 percent Sharpsburg and similar soils, and 30 percent minor soils.

Gara soils are strongly sloping to steep and on valley side slopes and nose slopes. They formed in glacial till, and are moderately well drained. Armstrong soils are moderately sloping and moderately steep, and on narrow, convex ridgetops, shoulder slopes, nose slopes, and valley side slopes. They formed in a thin mantle of sediments or loess and in the underlying paleosol weathered from glacial till, and are moderately well drained and somewhat poorly drained. Sharpsburg soils are gently sloping and moderately sloping, and on long and narrow, convex ridgetops, shoulder slopes, and side slopes. They formed in loess, and are moderately well drained. Gara and Armstrong soils formed under mixed vegetation of prairie grasses and deciduous trees. Sharpsburg soils formed under native vegetation of prairie grasses.

Typically, the surface layer of the Gara soils is very dark gray, friable loam about 7 inches thick. The subsurface layer is dark grayish brown and yellowish brown, friable loam about 3 inches thick. The subsoil extends to a depth of about 60 inches, and is mottled. In the upper part it is yellowish brown, friable clay loam. In the next part it is dark yellowish brown and yellowish brown, very firm clay. In the lower part it is yellowish brown, firm, calcareous clay loam, and has accumulations of lime. Stones and pebbles are in the subsoil.

Typically, the surface layer of the Armstrong soils is very dark gray, friable clay loam about 7 inches thick. It is mixed with streaks and pockets of brown subsoil material. The subsoil extends to a depth of about 60 inches, and is mottled. In the upper part it is brown, firm clay loam. In the next part it is strong brown and yellowish brown, very firm clay. In the lower part it is yellowish brown, grayish brown, and light brownish gray, firm clay loam.

Typically, the surface layer of the Sharpsburg soils is very dark brown and very dark grayish brown, friable silty clay loam about 8 inches thick. It is mixed with streaks and pockets of brown subsoil material. The subsoil is about 39 inches thick. In the upper part it is brown, friable and firm silty clay loam. In the next part it is dark yellowish brown, mottled, friable silty clay loam. In the lower part it is grayish brown and light brownish gray, mottled, friable silty clay loam. The substratum to a depth of about 60 inches is light brownish gray, mottled, friable silty clay loam.

The minor soils in this association are the Bucknell, Caleb, Colo, Mystic, and Olmitz soils. Bucknell soils formed in a thin mantle of sediments or loess and in the underlying, partly truncated, clayey paleosol that weathered from glacial till. They are in the upland coves and side slopes upslope from Gara and Armstrong soils. Caleb and Mystic soils formed in weathered alluvial sediments derived from glacial till on high terraces adjacent to major streams. Colo soils are poorly drained and formed in silty alluvium on bottom land along drainageways. They have a thick, dark colored surface soil. Olmitz soils formed in loamy alluvium on foot slopes adjacent to Gara soils, and have a thick, dark colored surface soil.

This association is used mainly for permanent pasture and hay. Some scattered, irregularly shaped areas are woodland. In most areas this association is moderately well suited to grasses and legumes for hay and pasture. Many ponds are built in these areas. They help to control water erosion, prevent gully formation, and provide water for livestock. Most of the gently sloping and moderately sloping areas are used for cultivated crops. They are moderately well suited to row crops and well suited to small grains and to grasses and legumes for hay and pasture. Cow-calf herds, hogs and sheep, and cash-grain crops are the major commodities. The main concerns of management are controlling water erosion, preventing the formation of gullies, and maintaining or improving fertility and tilth.

The major concerns in pasture management are overgrazing and grazing when the soils are wet, both of which cause erosion. A system of conservation tillage that leaves crop residue on the surface, contour farming, a cropping rotation that includes grasses and legumes, and terraces help to prevent excessive soil loss.

6. Lindley-Keswick-Weller Association

Moderately sloping to very steep, moderately well drained, loamy and silty soils formed in glacial till, in loess or sediments overlying a paleosol, and in loess; on uplands

This association consists of soils on long and narrow, convex ridgetops and short, convex shoulder slopes, nose slopes, and valley side slopes. Side slopes are dissected by many small drainageways and gullies that are uncrossable by farm machinery. Most of the strongly sloping to very steep areas are in native hardwoods. In most areas the landscape is gently rolling to very steep. Slopes range from 5 to 40 percent.

This association makes up about 4 percent of the county. It is about 44 percent Lindley soils, 25 percent Keswick soils, 16 percent Weller and similar soils, and 15 percent minor soils (fig. 5).

Lindley soils are strongly sloping to very steep and on narrow, convex ridgetops, valley side slopes, and nose slopes. They formed in glacial till. Keswick soils are strongly sloping and on narrow, convex ridgetops, shoulder slopes, nose slopes, and side slopes. They formed in a thin mantle of sediments or loess and in the underlying paleosol weathered from glacial till. Weller soils are moderately sloping and on long and narrow, convex ridgetops and shoulder slopes. They formed in

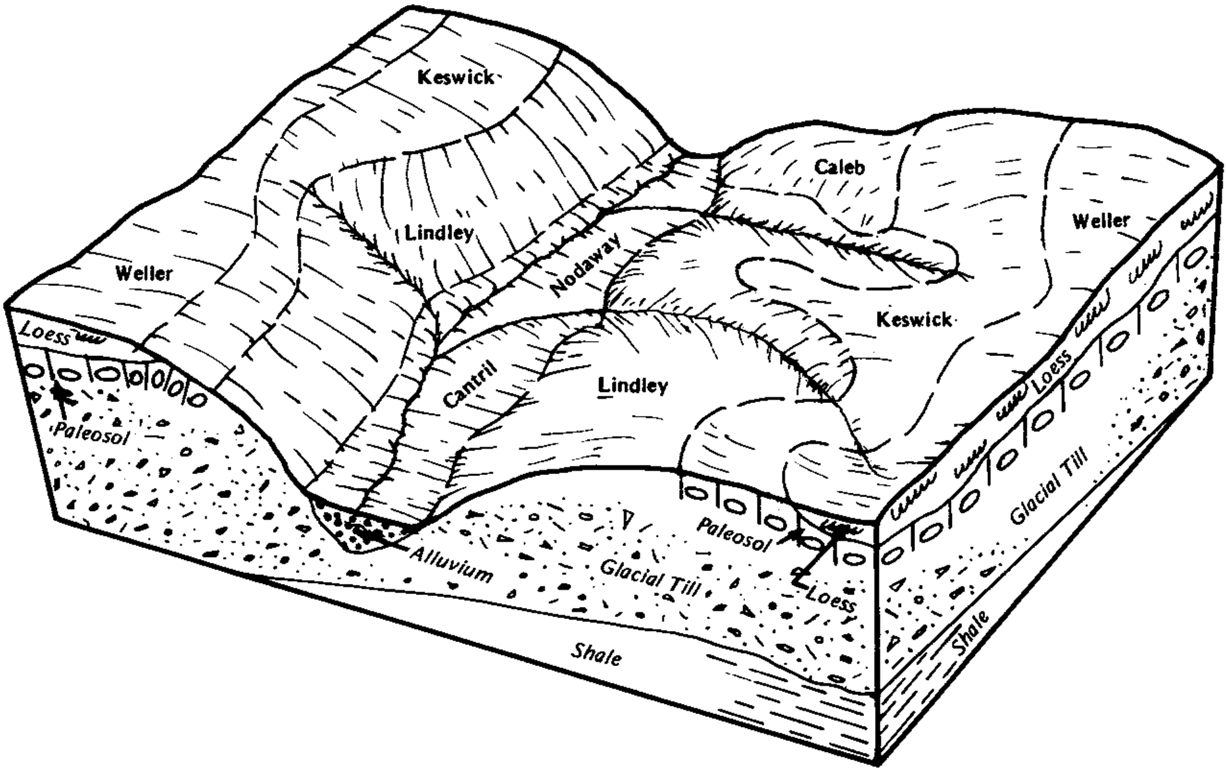

Figure 5.—Typical pattern of soils and underlying material in the Lindley-Keswick-Weller association.

loess. All three soils formed under native vegetation of deciduous trees.

Typically, the surface layer of the Lindley soils is very dark grayish brown, friable loam or clay loam about 3 inches thick. The subsurface layer is grayish brown and brown, friable loam about 6 inches thick. The subsoil is about 35 inches thick. In the upper part it is yellowish brown, friable and firm clay loam. In the next part it is yellowish brown and strong brown, mottled, very firm clay. In the lower part it is yellowish brown and light brownish gray, mottled, firm, calcareous clay loam, and has nodules and specks of lime. The substratum to a depth of about 60 inches is light brownish gray and yellowish brown, mottled, firm, calcareous clay loam.

Typically, the surface layer of the Keswick soils is very dark gray, friable loam about 3 inches thick. The subsurface layer is brown and yellowish brown, friable loam about 6 inches thick. The subsoil extends to a depth of about 60 inches, and is mottled. In the upper part it is yellowish brown, friable loam. In the next part it is yellowish red, red, strong brown, and gray, very firm clay. In the lower part it is yellowish brown, grayish brown, and gray, firm clay loam.

Typically, the surface layer of the Weller soils is very dark grayish brown, friable silt loam about 3 inches thick. The subsurface layer is dark grayish brown and brown, friable silt loam about 6 inches thick. The subsoil extends to a depth of about 60 inches. In the upper part it is yellowish brown, mottled, friable silt loam and silty clay loam. In the next part it is yellowish brown and brown, mottled, very firm and firm silty clay. In the lower part it is grayish brown, yellowish brown, and light brownish gray, mottled, friable silty clay loam.

The minor soils in this association are the Bucknell, Caleb, Cantril, Mystic, and Nodaway soils. Bucknell soils are somewhat poorly drained, and formed in a thin mantle of sediments or loess and in an underlying, partly truncated paleosol weathered from glacial till. They are in the upland coves and on side slopes. Caleb and Mystic soils formed in weathered alluvial sediments derived from glacial till on high terraces adjacent to major streams. Cantril soils are somewhat poorly drained, and formed in loamy local alluvium on foot slopes and alluvial fans. Nodaway soils formed in stratified, silty alluvium in areas of bottom land close to stream channels.

This association is used mainly as woodland, wildlife habitat, and permanent pasture. In most areas it is moderately well suited to trees and permanent pasture. Some of the moderately sloping areas are used for cultivated crops or pasture. They are moderately well suited to these uses.

The main enterprises of this association are cutting firewood, hunting, and raising cow-calf herds. The main concerns of management are controlling water erosion in areas that have been cleared, preventing gully formation, and maintaining or improving fertility and tilth. Establishing a protective plant cover is difficult on cleared, steeper slopes. Woodland areas of this association can be improved through woodland management. Habitat for woodland wildlife can be improved by constructing water impoundment reservoirs, excluding livestock, and establishing food plots adjacent to wooded areas.

7. Macksburg-Nira-Clarinda Association

Nearly level to strongly sloping, moderately well drained to poorly drained, silty soils formed in loess and in loess or sediments overlying a paleosol weathered from glacial till; on uplands

This association consists of soils on moderately broad flats, long and narrow convex ridgetops, shoulder slopes, side slopes, and in coves at the heads of drainageways. In most areas the landscape is nearly level to rolling. Slopes range from 0 to 14 percent.

This association makes up about 4 percent of the county. It is about 40 percent Macksburg and similar soils, 30 percent Nira and similar soils, 18 percent Clarinda soils, and 12 percent minor soils (fig. 6).

Macksburg soils are nearly level and gently sloping and on moderately broad flats and moderately wide ridgetops and shoulder slopes. They formed in loess, and are somewhat poorly drained. Nira soils are moderately sloping and on convex shoulder slopes and head slopes. They formed in loess and are moderately well drained. Clarinda soils are moderately sloping and strongly sloping and on side slopes and in coves at the heads of drainageways. They formed in a thin mantle of loess and in the underlying, exhumed, gray, clayey paleosol weathered from glacial till, and are poorly drained. All three soils formed under native vegetation of prairie grasses.

Typically, the surface layer of the Macksburg soils is black, friable silty clay loam about 10 inches thick. The subsurface layer is black and very dark grayish brown, friable silty clay loam about 9 inches thick. The subsoil is about 35 inches thick. In the upper part it is brown and dark grayish brown, mottled, firm silty clay loam. In the next part it is grayish brown, mottled, firm silty clay and silty clay loam. In the lower part it is light brownish gray, mottled, friable silty clay loam. The substratum to a depth of about 60 inches is light brownish gray, mottled, friable silty clay loam.

Typically, the surface layer of the Nira soils is very dark gray, friable silty clay loam about 8 inches thick. It is mixed with streaks and pockets of brown subsoil material. The subsoil is mottled, friable silty clay loam about 37 inches thick. In the upper part it is brown, in the next part it is grayish brown, and in the lower part it is light brownish gray. The substratum to a depth of about 60 inches is light olive gray, mottled, friable silty clay loam.

Typically, the surface layer of the Clarinda soils is very dark gray, friable silty clay loam about 7 inches thick. It is mixed with streaks and pockets of dark gray and dark grayish brown silty clay subsoil material. The subsoil extends to a depth of about 60 inches. It is mottled and very firm. In the upper part it is dark gray silty clay, and in the lower part it is gray and light gray clay.

The minor soils in this association are the Clearfield, Colo, Lamoni, and Zook soils. Clearfield soils formed in loess and in the underlying, exhumed, gray clayey paleosol weathered from glacial till. They are on side slopes and head slopes in the upland coves, and are poorly drained. Colo and Zook soils formed in silty alluvium on bottom land along the drainageways. They have a thick, dark colored surface soil, and are poorly drained. Lamoni soils formed in a thin mantle of sediments or loess and in the underlying, partly truncated paleosol weathered from glacial till. They are on shoulder slopes and side slopes, and are somewhat poorly drained.

This association is used mainly for cultivated crops. In nearly level and gently sloping areas it is well suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. The moderately sloping Nira soils are moderately well suited to corn, soybeans, and small grains. They are well suited to grasses and legumes for hay and pasture. The moderately sloping and strongly sloping Clarinda soils are poorly suited to row crops and are best suited to grasses and legumes for pasture and hay. The major agricultural activities in this association are growing cash-grain crops and feeding livestock. The main concerns of management

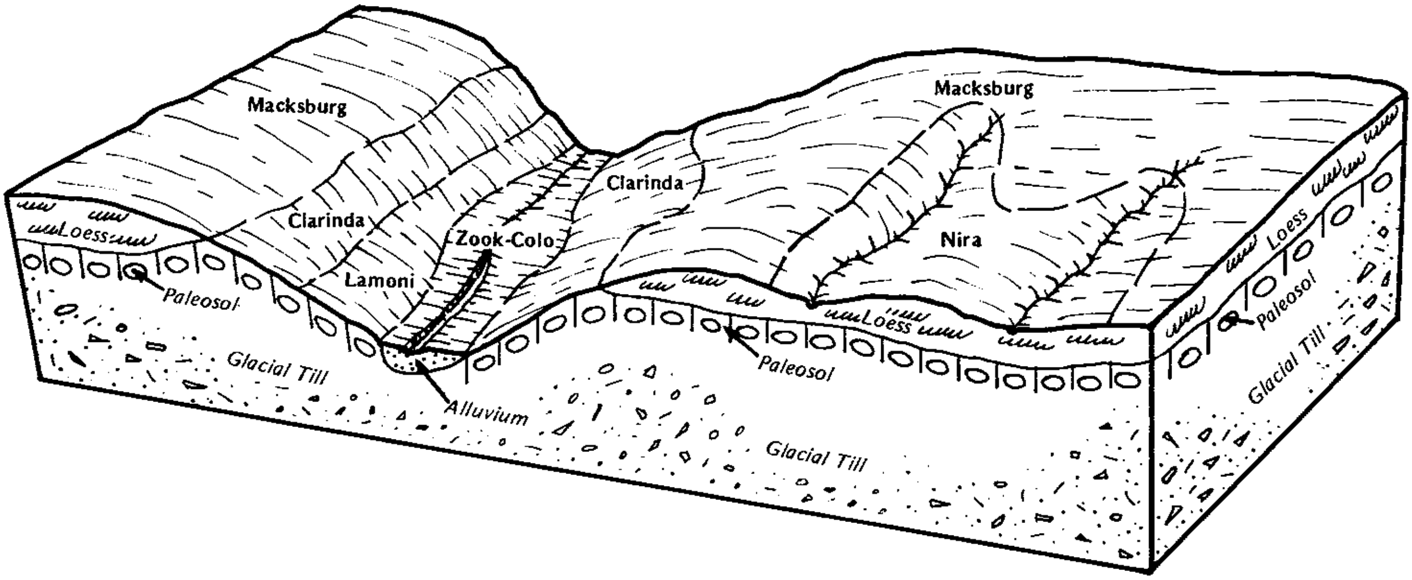

Figure 6.—Typical pattern of soils and underlying material in the Macksburg-Nira-Clarinda association.

are controlling water erosion and improving fertility and tilth. Subsurface drainage is beneficial for timely field operations. Water erosion is a severe hazard if row crops are grown in moderately sloping and strongly sloping areas. A system of conservation tillage that leaves crop residue on the surface, contour farming, stripcropping, a cropping rotation that includes grasses and legumes, and terraces help to prevent excessive soil loss.

8. Lawson-Zook Association

Nearly level, somewhat poorly drained and poorly drained, silty soils formed in alluvium; on bottom land

This association consists of soils on bottom land and alluvial fans along the major streams. These soils are subject to flooding. Slopes range from 0 to 2 percent.

This association makes up about 5 percent of the county. It is about 45 percent Lawson and similar soils, 28 percent Zook and similar soils, and 27 percent minor soils.

Lawson soils are somewhat poorly drained and commonly adjacent to stream channels. Zook soils are poorly drained and adjacent to upland foot slopes. These soils formed under native vegetation of tall prairie grasses tolerant of wetness.

Typically, the surface layer of the Lawson soils is very dark brown, friable silt loam about 9 inches thick. The subsurface layer is friable silt loam about 21 inches thick, and is mottled. It is very dark brown in the upper part and very dark grayish brown in the lower part. The substratum to a depth of about 60 inches is very dark grayish brown and dark grayish brown, mottled, friable silt loam.

Typically, the surface layer of the Zook soils is black, friable silty clay loam about 10 inches thick. The subsurface layer is black and about 26 inches thick. It is friable and firm silty clay loam in the upper part and firm silty clay in the lower part. The subsoil is very dark gray and dark gray, very firm and firm silty clay about 22 inches thick. The substratum to a depth of about 60 inches is dark gray, firm silty clay.

The minor soils in this association are the Humeston, Olmitz, and Vesser soils. Humeston and Vesser soils are on low stream terraces, are less subject to flooding, and have strongly expressed horizons. Olmitz soils are moderately well drained, and formed in loamy, local alluvium on foot slopes and alluvial fans.

This association is used mainly for cultivated crops. Areas characterized by meandering stream channels and narrow stream valleys are used as pasture, woodland, or wildlife habitat. The major commodity is cash-grain crops. The soils in this association generally are well suited and moderately well suited to cultivated crops if they are protected from flooding and adequately drained. The main concerns of management are protecting the soils from floods, improving drainage, and maintaining or improving fertility and tilth. Diversions, levees, and channel improvements help to control floodwater and runoff from adjacent areas. Poorly drained soils can be drained by tile and surface drains if adequate outlets are available.

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, Lamoni clay loam, 5 to 9 percent slopes, is a phase of the Lamoni series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Olmitz-Zook-Colo complex, 0 to 5 percent slopes, is an example.

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

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

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

13B—Olmitz-Zook-Colo complex, 0 to 5 percent slopes. These nearly level and gently sloping soils are in narrow drainageways and on narrow foot slopes. The moderately well drained Olmitz soil is on the upper part of slopes. The poorly drained Zook and Colo soils are on the lower part of slopes nearer the stream channels, and are subject to flooding. The Zook soil is in the nearly level parts of this map unit. Areas are long and narrow and range from 10 to more than 100 acres in size. They are about 40 percent Olmitz soil, 30 percent Zook soil, and 20 percent Colo soil. The three soils occur as areas so intricately mixed or so small and narrow that mapping them separately is not practical.

Typically, the surface layer of the Olmitz soil is very dark brown, friable loam about 9 inches thick. The subsurface layer is about 22 inches thick. The upper part is very dark brown, friable clay loam, and the lower part is very dark grayish brown, friable clay loam. The subsoil extends to a depth of about 60 inches. It is friable clay loam. The upper part is brown, and the lower part is dark yellowish brown. In some places the subsoil has a higher clay content and is somewhat poorly drained.

Typically, the surface layer of the Zook soil is black, friable silty clay loam about 10 inches thick. The subsurface layer is about 26 inches thick, and is black. It is friable silty clay loam in the upper part and firm silty clay in the lower part. The subsoil is very dark gray and dark gray, very firm and firm silty clay about 22 inches thick. The substratum to a depth of about 60 inches is dark gray, firm silty clay. In some places the subsoil has more clay.

Typically, the surface layer of the Colo soil is black, friable silty clay loam about 9 inches thick. The subsurface layer is black, friable silty clay loam about 26 inches thick. The subsoil is mottled, friable silty clay loam about 22 inches thick. The upper part is very dark gray, and the lower part is gray. The substratum to a depth of about 60 inches is gray, mottled, friable silty clay loam.

Included with these soils in mapping are small areas of Humeston and Nodaway soils. The poorly drained Humeston soils are in slightly higher concave positions than the Colo and Zook soils. These soils are more difficult to drain than the Colo and Zook soils. The moderately well drained, stratified Nodaway soils are nearer the stream channels and lower in clay content than the Colo, Olmitz, and Zook soils. Included soils make up about 10 percent of the map unit.

Permeability is moderate in the Olmitz and Colo soils and slow in the Zook soil. The surface runoff is medium on the Olmitz soil and slow on the Colo and Zook soils. Available water capacity is high in all three soils. The Colo soil has a seasonal high water table at a depth of 1 to 3 feet. The Zook soil has a seasonal high water table between the surface and a depth of 3 feet, and has high shrink-swell potential. The content of organic matter is about 3 or 4 percent in the surface layer of the Olmitz soil, and is about 5 to 7 percent in the surface layer of the Colo and Zook soils. The supply of available phosphorus is very low and that of available potassium is low in the subsurface layer and subsoil of the Olmitz soil. The supply of available phosphorus is medium in the subsurface layer and subsoil of Colo and Zook soils, and that of available potassium is low in the subsurface layer and subsoil of the Zook soil and very low in the subsurface layer and subsoil of the Colo soil. The soils in this map unit have fair tilth, and tend to puddle if worked when wet.

Most areas are managed along with the adjacent soils as pasture, hayland, or row crops. A few areas are woodland, and provide good wildlife habitat. These soils are moderately well suited to corn, soybeans, and small grains, and are well suited to grasses and legumes for hay and pasture. In many areas, row crops can be grown if the soils are drained and protected from floodwater. A subsurface drainage system is needed. Tile drains work satisfactorily if adequate outlets are available. In many areas diversions are needed to protect the soils from runoff from adjacent upslope areas. Ridge planting, a planting method in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and the low soil temperature. Many areas are dissected by gullies and waterways that cannot be crossed by farm machinery.

These soils are suited to grasses and legumes for hay and pasture. Overgrazing or grazing when these soils are too wet, however, causes surface compaction which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and these soils in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland.

The land capability classification is IIw.

23C—Arispe silty clay loam, 5 to 9 percent slopes. This moderately sloping, somewhat poorly drained soil is on short, convex side slopes, in coves at the heads of drainageways, and on low, narrow ridges on loess-covered uplands. Areas are long and narrow or irregularly shaped, and commonly range from 5 to 30 or more acres in size.

Typically, the surface layer is black, friable silty clay loam about 9 inches thick. The subsurface layer is very dark gray, firm silty clay loam about 4 inches thick. The subsoil is about 40 inches thick, and mottled. The upper part is dark grayish brown, firm silty clay loam. The next part is dark grayish brown and grayish brown, firm silty clay. The lower part is grayish brown and light brownish gray, firm and friable silty clay loam. The substratum to a depth of about 60 inches is light olive gray, mottled, friable silty clay loam. In some places the surface layer is mixed with streaks and pockets of dark grayish brown subsoil material.

Included with this soil in mapping are small areas of Clarinda and Lamoni soils. These soils formed in a thin mantle of loess or pedisediments and in the underlying paleosol that weathered from glacial till. They are on the lower part of side slopes. They are more difficult to prepare as seedbeds, and are seepy and wet in spring.

They make up 5 to 10 percent of the map unit.

Permeability of this Arispe soil is moderately slow. Surface runoff is medium. Available water capacity is high. This soil has a seasonal high water table at a depth of 2 to 4 feet. The shrink-swell potential is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium. This soil has good tilth, but tends to puddle if worked when wet.

Many areas are pasture or hayland. Some areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grains, and is well suited to grasses and legumes for hay and pasture. If this soil is used continuously for cultivated crops, water erosion is a severe hazard. In intensively row-cropped areas erosion can be adequately controlled through a combination of soil conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour stripcropping, contour farming, grassed headlands, grassed waterways, terraces, and a crop rotation that includes grasses and legumes. A combination of tile drainage and terraces allows timelier field operations during wet springs and helps to control erosion. If terraces are built, topsoil should be stockpiled and spread over the excavated and built-up areas to facilitate the restoration of productivity. Regular addition of organic material to the soil improves soil fertility, maintains good tilth, and increases the rate of water infiltration.

This soil is best suited to grasses and legumes for hay and pasture. A cover of hay or pasture plants is also effective in controlling soil erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

The land capability classification is IIIe.

23C2—Arispe silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, somewhat poorly drained soil is on short, convex side slopes, in the coves of drainageways, and on low, narrow interfluves on loess-covered uplands. Areas are long and narrow or irregularly shaped, and commonly range from 5 to 100 acres in size.

Typically, the surface layer is black, friable silty clay loam about 8 inches thick. It is mixed with streaks and pockets of dark grayish brown subsoil material. The subsoil is about 37 inches thick. It is mottled. The upper part is dark grayish brown and grayish brown, firm silty clay. The next part is grayish brown, firm silty clay loam. The lower part is light brownish gray, friable silty clay loam. The substratum to a depth of about 60 inches is light brownish gray, mottled, friable silty clay loam. In some places the surface layer and subsurface layer are black and very dark gray, friable silty clay loam 10 inches thick or more. In small, severely eroded areas the surface layer is mostly dark grayish brown, firm silty clay loam.

Included with this soil in mapping are small areas of Clarinda and Lamoni soils. These soils formed in a thin mantle of loess or pedisediments and in the underlying paleosol that weathered from glacial till. These areas are on the lower part of side slopes in the landscape. These areas are more difficult to prepare as seedbeds, and are seepy and wet in spring. They make up 5 to 10 percent of the map unit.

Permeability of this Arispe soil is moderately slow. Surface runoff is medium. Available water capacity is high. This soil has a seasonal high water table at a depth of 2 to 4 feet. The shrink-swell potential is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium. This soil has fair tilth, and tends to puddle if worked when wet.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grains, and is well suited to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a severe hazard. Water erosion can be adequately controlled in intensively row-cropped areas through a combination of soil conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour stripcropping, contour farming, grassed headlands, grassed waterways (fig. 7), terraces, and a cropping rotation that includes grasses and legumes. A combination of tile drainage and terraces allows timelier field operations during wet springs and helps to control

Figure 7.—A newly established grassed waterway on Arispe silty clay loam, 5 to 9 percent slopes, moderately eroded. Grassed waterways are generally the best means for carrying concentrated runoff from the field.

erosion. If terraces are built, topsoil should be stockpiled and spread over the excavated and built-up areas to facilitate restoration of productivity. Regular addition of organic material to the soil improves soil fertility and tilth, and increases the rate of water infiltration. This soil generally needs more nitrogen than the uneroded Arispe soils, and requires greater production inputs to maintain higher yields and to maintain or improve tilth.

This soil is suited to grasses and legumes for hay and pasture (fig. 8). A cover of hay or pasture plants is also effective in controlling soil erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

The land capability classification is IIIe.

24D—Shelby loam, 9 to 14 percent slopes. This strongly sloping, moderately well drained soil is on convex side slopes on uplands. Slopes typically are short. Most areas are irregular in shape, but some are long and narrow. Areas range from 5 to 20 acres in size.

Typically, the surface layer is very dark brown, friable loam about 9 inches thick. The subsurface layer is dark brown, friable clay loam about 6 inches thick. The subsoil to a depth of about 60 inches is firm clay loam. The upper part is brown and dark yellowish brown. The next part is yellowish brown and mottled. The lower part is strong brown and light brownish gray and mottled. There are pebbles and stones in the subsoil and substratum. In some places the surface layer is mixed with streaks and pockets of brown clay loam subsoil material.

Included with this soil in mapping are small areas of Adair and Lamoni soils. Adair and Lamoni soils have more clay in the subsoil than the Shelby soil. These soils are on the upper part of side slopes. They make up about 10 percent of the map unit.

Permeability of this Shelby soil is moderately slow. Surface runoff is rapid. Available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has good tilth, but tends to puddle if worked when wet and becomes hard and cloddy when dry.

Many areas are used for hay and pasture. Some areas are cultivated. In most areas this soil is managed along with adjacent soils. It is moderately well suited to corn, soybeans, and small grains, and is well suited to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a severe hazard. Water erosion can be adequately controlled in row-cropped areas through a combination of soil conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour stripcropping, contour farming, grassed waterways, terraces, and a cropping rotation that includes grasses and legumes. Conservation practices upslope that increase infiltration will also help to control erosion on this soil. Regular additions of organic material to the soil improve soil fertility, maintain good tilth, and increase the rate of water infiltration.

This soil is best suited to grasses and legumes for hay and pasture. A cover of hay or pasture plants is also effective in controlling soil erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. In some places terraces and diversions may be needed to protect critically seeded areas.

The land capability classification is IIIe.

24D2—Shelby clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on convex side slopes on uplands. Slopes typically are short. Most areas are irregular in shape, but some are long and narrow. Areas range from 5 to 30 acres in size.

Typically, the surface layer is very dark brown, friable clay loam about 8 inches thick. It is mixed with streaks and pockets of dark yellowish brown subsoil material. The subsoil is about 38 inches thick, and is firm clay loam. The upper part is dark yellowish brown; the next part is yellowish brown and mottled; and the lower part is yellowish brown and light brownish gray and mottled. The substratum to a depth of about 60 inches is light brownish gray, mottled, firm clay loam. Pebbles and stones are in the subsoil and substratum. In some places the surface layer and subsurface layer are 10 inches thick or more.

Included with this soil in mapping are small areas of Adair and Lamoni soils. Adair and Lamoni soils have more clay in the subsoil than the Shelby soil. They are on the upper part of side slopes. In some areas, the surface layer is mostly dark yellowish brown clay loam. These areas, which are scattered throughout the map unit, have poor tilth and are difficult to manage. They require greater production inputs to maintain high yields. Included areas make up about 10 percent of the map unit.

Permeability of this Shelby soil is moderately slow. Surface runoff is rapid. Available water capacity is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and available

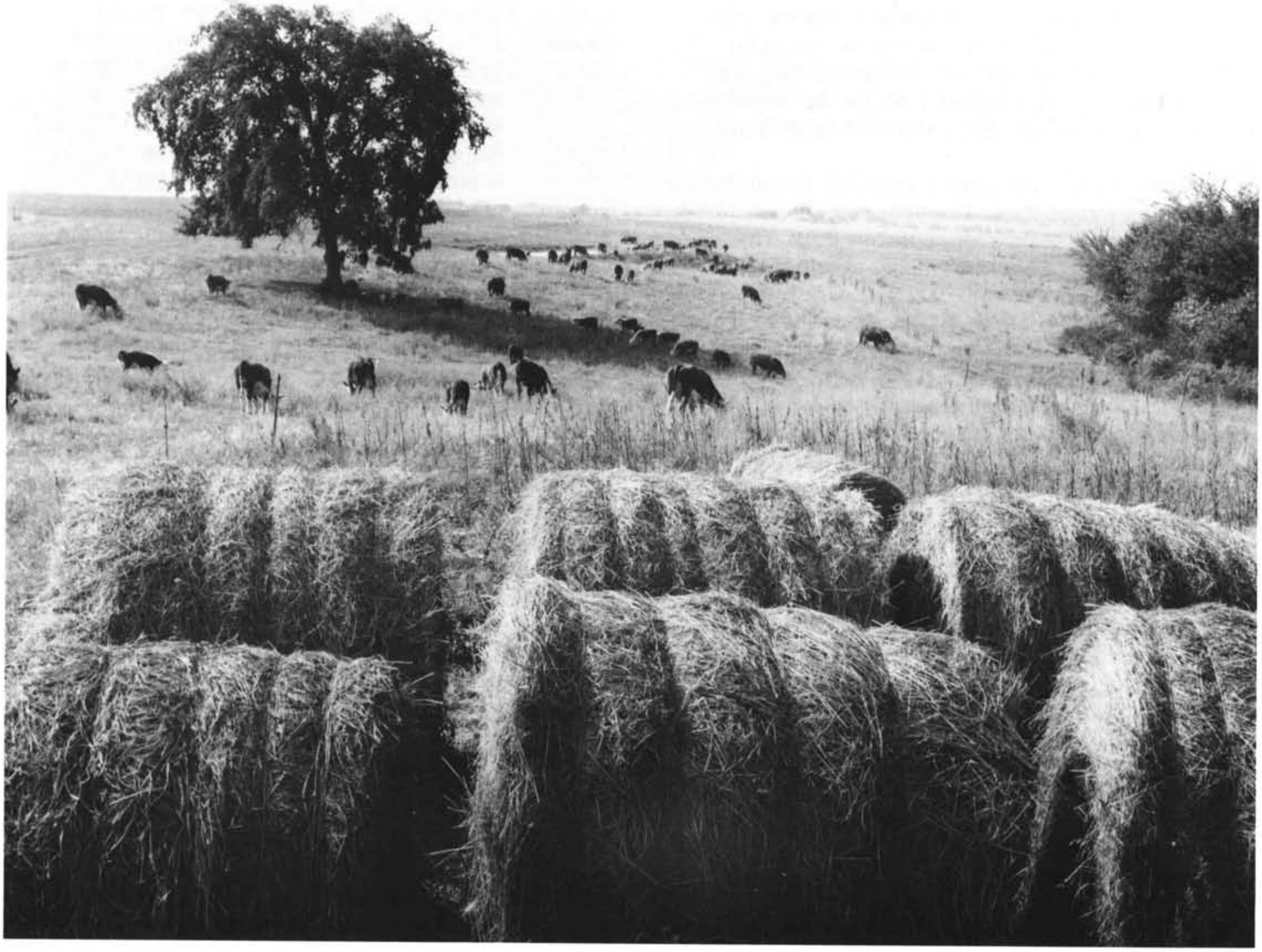

Figure 8.—An area of Arispe silty clay loam, 5 to 9 percent slopes, moderately eroded, used for pasture and hay.

potassium. This soil has good tilth, but tends to puddle if worked when wet.

Most areas are cultivated, and some areas are used for pasture. In most areas this soil is managed along with adjacent soils. It is moderately well suited to corn, soybeans, and small grains, and is well suited to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a severe hazard. Water erosion can be adequately controlled in row-cropped areas through a combination of soil conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour stripcropping, contour farming, grassed waterways, terraces, and a cropping rotation that includes grasses and legumes. In some places medium- and large-size stones from the subsoil may also interfere with some tillage operations. Conservation practices upslope which increase infiltration will also help to control water erosion on this soil. Regular additions of organic material to the soil improve soil fertility, maintain good tilth, and increase the rate of water infiltration. This soil generally needs more nitrogen than the uneroded Shelby soils, and requires greater production inputs to maintain high yields and to maintain or improve tilth.

This soil is best suited to grasses and legumes for hay and pasture. A cover of hay or pasture plants is also effective in controlling water erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime will help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. In some places terraces and diversions may be needed to protect critically seeded areas.

The land capability classification is IIIe.

24E—Shelby loam, 14 to 18 percent slopes. This moderately steep, moderately well drained soil is on convex valley side slopes on uplands. Areas are long and narrow or irregularly shaped, and commonly range from 5 to 40 acres in size.

Typically, the surface layer is very dark brown, friable loam about 9 inches thick. The subsurface layer is dark brown, friable clay loam about 4 inches thick. The subsoil to a depth of about 60 inches is mottled, firm clay loam. The upper part is dark yellowish brown. The next part is dark yellowish brown and yellowish brown. The lower part is yellowish brown and light brownish gray. Pebbles and stones are throughout the profile. In small, moderately eroded areas, the surface layer is mixed with streaks and pockets of dark yellowish brown clay loam subsoil material. In some places, the slopes are steeper.

Included with this soil in mapping are small areas of Adair and Lamoni soils. Adair and Lamoni soils have more clay in the subsoil than the Shelby soil. They are on the upper part of side slopes, and make up about 10 percent of the map unit.

Permeability of this Shelby soil is moderately slow. Surface runoff is rapid. Available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has good tilth, but tends to puddle if worked when wet.

Most areas are used for hay and pasture, but a few areas are cultivated. This soil is poorly suited to corn, soybeans, and small grains, and is moderately well suited to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a severe hazard. Water erosion can be adequately controlled for occasional row crops through a combination of conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour stripcropping, contour farming, grassed waterways, and a cropping rotation that includes grasses and legumes. Conservation practices upslope that increase infiltration and reduce runoff will also help to control erosion. Regular additions of organic material to the soil improve soil fertility, maintain good tilth, and increase the rate of water infiltration.

This soil is best suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay is also effective in controlling water erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. In some places terraces and diversions may be needed to protect critically seeded areas.

The land capability classification is IVe.

24E2—Shelby clay loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, moderately well drained soil is on convex, valley side slopes on uplands. Areas are long and narrow or irregularly shaped, and commonly range from 5 to 50 acres in size.

Typically, the surface layer is very dark brown, friable clay loam about 8 inches thick. It is mixed with streaks and pockets of dark yellowish brown subsoil material. The subsoil to a depth of about 60 inches is mottled, firm clay loam. The upper part is dark yellowish brown. The next part is dark yellowish brown and yellowish brown. The lower part is yellowish brown. Pebbles and stones are throughout the profile, and a few of these are scattered on the surface. In some places the surface layer and subsurface layer are 10 inches thick or more. In other places the slopes are steeper.

Included with this soil in mapping are small areas of Adair and Lamoni soils. Adair and Lamoni soils have more clay in the subsoil than the Shelby soil. They are on the upper part of side slopes. In some areas the surface layer is mostly dark yellowish brown clay loam. These areas have poor tilth, and are difficult to manage. They require greater production inputs to maintain high yields. Included areas make up 10 to 15 percent of the map unit.

Permeability of this Shelby soil is moderately slow. Surface runoff is rapid. Available water capacity is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has fair tilth, and tends to puddle if worked when wet.

Most areas are used for row crops, pasture, or hay. This soil is poorly suited to corn, soybeans, and small grains, and is moderately well suited to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a severe hazard. Water erosion can be adequately controlled for occasional row crops through a combination of soil conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed waterways, and a cropping rotation that includes grasses and legumes. Conservation practices upslope that increase infiltration and reduce runoff will also help to control erosion on this soil. Regular additions of organic material to the soil improve fertility and tilth, and increase the rate of water infiltration. This soil generally needs more nitrogen than the uneroded Shelby soils, and requires greater production inputs to maintain high yields and to maintain or improve tilth.

This soil is best suited to grasses and legumes for hay and pasture. A cover of hay or pasture plants is also effective in controlling water erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. In some places terraces and diversions may be needed to protect critically seeded areas.

The land capability classification is IVe.

24E3—Shelby clay loam, 14 to 18 percent slopes, severely eroded. This moderately steep, moderately well drained soil is on convex nose slopes and valley side slopes on uplands. Areas are long and narrow or irregularly shaped, and commonly range from 5 to 25 acres in size.

Typically, the surface layer is dark yellowish brown, friable clay loam about 8 inches thick. It is mixed with 20 to 25 percent streaks and pockets of very dark brown loam from the original surface layer. The subsoil is mottled, firm clay loam about 41 inches thick. The upper part is dark yellowish brown; the next part is yellowish brown; and the lower part is yellowish brown, and is calcareous. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm, calcareous clay loam. Stones and pebbles are on the surface, in the subsoil, and in the substratum. In some places the surface layer is mostly very dark brown clay loam about 8 inches thick.

Included with this soil in mapping are small areas of Adair and Lamoni soils on the upper part of side slopes. These soils have more clay in the subsoil, and typically are not as well drained as the Shelby soil. They make up about 10 percent of the map unit.

Permeability of this Shelby soil is moderately slow. Surface runoff is rapid. Available water capacity is high. The content of organic matter is about 1 to 2 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has poor tilth, and tends to puddle if worked when wet.

Most areas are cultivated, but some are used for pasture. This soil generally is poorly suited to corn and soybeans because further water erosion is a severe hazard. It is best suited to small grains and to grasses and legumes for hay and pasture.

This soil is moderately well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay is also effective in controlling water erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. In some places terraces and diversions may be needed to protect critically seeded areas.

The land capability classification is IVe.

24F—Shelby loam, 18 to 25 percent slopes. This steep, moderately well drained soil is on convex, valley side slopes on uplands. Areas are long and narrow or irregularly shaped, and commonly range from 3 to 20 acres in size.

Typically, the surface layer is very dark brown, friable loam about 10 inches thick. The subsurface layer is very dark grayish brown and dark brown, friable clay loam about 4 inches thick. The subsoil is mottled, firm clay loam about 42 inches thick. The upper part is dark yellowish brown. The next part is dark yellowish brown and yellowish brown. The lower part is yellowish brown, and is calcareous. The substratum to a depth of about 60 inches is mottled yellowish brown and grayish brown, firm, calcareous clay loam. Stones and pebbles are in the subsoil and substratum. In some places the surface layer is mixed with streaks and pockets of dark yellowish brown clay loam subsoil material.

Included with this soil in mapping are small areas of Adair and Lamoni soils. These soils contain more clay in the subsoil than the Shelby soil. These soils are on the upper part of side slopes. They make up 5 to 10 percent of the map unit.

Permeability of this Shelby soil is moderately slow. Surface runoff is very rapid. Available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has good tilth, but tends to puddle if worked when wet.

Most areas are used for pasture and hayland. This soil generally is unsuited to corn, soybeans, and small grains, mainly because of the slope and the severe hazard of water erosion. It is best suited to grasses and legumes for hay and pasture.

This soil is moderately well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay is also effective in controlling water erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. In some places terraces and diversions may be needed to protect critically seeded areas.

The land capability classification is VIe.

24F2—Shelby clay loam, 18 to 25 percent slopes, moderately eroded. This steep, moderately well drained soil is on convex, valley side slopes on uplands. Areas are long and narrow or irregularly shaped, and commonly range from 5 to 40 acres in size.

Typically, the surface layer is very dark brown, friable clay loam about 8 inches thick. It is mixed with streaks and pockets of brown subsoil material. The subsoil is mottled, firm clay loam about 36 inches thick. The upper part is brown and dark yellowish brown. The next part is dark yellowish brown and yellowish brown. The lower part is yellowish brown and light brownish gray. The substratum to a depth of 60 inches is yellowish brown and light brownish gray, mottled, firm, calcareous clay loam. Stones and pebbles are in the subsoil and substratum. In some places the surface layer and subsurface layer are very dark brown loam 10 inches thick or more. In some small, severely eroded areas the surface layer is mostly dark yellowish brown clay loam. In these places stones and pebbles are on the surface.

Included with this soil in mapping are small areas of Adair and Lamoni soils on the less sloping shoulder slopes. These soils contain more clay in the subsoil than the Shelby soil. They make up about 10 percent of the map unit.

Permeability of this Shelby soil is moderately slow. Surface runoff is very rapid. Available water capacity is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has fair tilth, and tends to puddle if worked when wet.

Most areas are used for pasture and hayland, but some are cultivated. This soil generally is unsuited to corn, soybeans, and small grains, mainly because of the slope and the severe hazard of further water erosion. It is best suited to grasses and legumes for hay and pasture.

This soil is moderately well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay is also effective in controlling water erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely application of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding the grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. In some places terraces and diversions may be needed to protect critically seeded areas.

The land capability classification is VIe.

51—Vesser silt loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on the higher areas of bottom land and on foot slopes and alluvial fans. It is subject to flooding. Areas are irregular in shape, and range from 5 to 40 or more acres in size.

Typically, the surface layer is very dark gray, friable silt loam about 9 inches thick. The subsurface layer is very dark gray, dark gray, and gray, mottled, friable silt loam about 23 inches thick. The subsoil extends to a depth of about 60 inches or more. It is mottled silty clay loam. The upper part is dark gray and friable, the next part is dark gray and firm, and the lower part is very dark grayish brown and dark grayish brown and firm. In some places the dark gray and gray subsurface layer is thinner. In some places the surface layer is silty clay loam.

Included with this soil in mapping are small areas of the Zook soils. These soils contain more clay and are more difficult to drain than this Vesser soil. The Zook soils are slightly lower in the landscape than the Vesser soil. They make up 5 to 10 percent of the map unit.

Permeability of this Vesser soil is moderate. Surface runoff is slow. The soil has a seasonal high water table at a depth of 1 to 3 feet. Available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. This soil has fair tilth, but tends to puddle if worked when wet.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grains. It is well suited to grasses and legumes for hay and pasture. Row crops can be grown in many years if the soil is adequately drained and protected from floodwater. Tile drains function satisfactorily if proper outlets are available. In many areas diversions are needed to protect the soil from the runoff from the adjacent higher areas. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and the low soil temperature in spring.

This soil is best suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland.

The land capability classification is IIw.

51B—Vesser silt loam, 2 to 5 percent slopes. This gently sloping, poorly drained soil is on the higher areas of bottom land and on foot slopes and alluvial fans. It is subject to flooding. Areas are irregular in shape, and range from 5 to 20 or more acres in size.

Typically, the surface layer is very dark gray, friable silt loam about 9 inches thick. The subsurface layer is very dark gray, dark gray, and gray, friable silt loam about 23 inches thick. It is mottled in the lower part. The subsoil extends to a depth of about 60 inches or more. It is mottled silty clay loam. The upper part is dark gray and friable. The next part is dark gray and firm. The lower part is very dark grayish brown and dark grayish brown and firm. In some places the dark gray and gray subsurface layer is thinner. In some places the surface layer is silty clay loam.

Included with this soil in mapping are small areas of soils that have a thinner surface layer and more clay in the subsoil than the Vesser soil. These soils are more difficult to drain than the Vesser soil, and are in similar landscape positions. Included areas make up 5 to 10 percent of the map unit.

Permeability of this Vesser soil is moderate. Surface runoff is medium. The soil has a seasonal high water table at a depth of 1 to 3 feet. Available water capacity is high. The content of organic matter is about 2.5 to 3.5 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. This soil has fair tilth, but tends to puddle if worked when wet.

Most areas are cultivated. Some areas are in pasture. This soil is moderately well suited to corn, soybeans, and small grains, and is well suited to grasses and legumes for hay and pasture. In many years row crops can be grown if the soil is adequately drained and protected from floodwater. Tile drains function satisfactorily if proper outlets are available. In many areas diversions are needed to protect the soil from the runoff from the adjacent higher areas. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and low soil temperature in spring.

This soil is best suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland.

The land capability classification is IIw.

54—Zook silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on bottom land. It is subject to flooding. Areas are irregular in shape, and commonly range from 7 to 50 acres in size.

Typically, the surface layer is black, friable silty clay loam about 10 inches thick. The subsurface layer is black and about 26 inches thick. It is friable and firm silty clay loam in the upper part and firm silty clay in the lower part. The subsoil is very dark gray and dark gray, very firm and firm silty clay about 22 inches thick. The substratum to a depth of about 60 inches is dark gray, firm silty clay. In some places the subsoil has more clay.

Permeability of this Zook soil is slow. Surface runoff is slow. The soil has a seasonal high water table at the surface or to a depth of 3 feet. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 5 to 7 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium. This soil has fair tilth, but tends to puddle if worked when wet.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. In many years row crops can be grown if the soil is adequately drained and protected from floodwater. A drainage system is needed to reduce the excess water and to provide good aeration and a deep root zone for plants. Tile drains generally work satisfactorily only if they are closely spaced and if an adequate outlet is available. In some areas surface drains are needed to remove excess water. In many areas diversions are needed to protect the soil from the runoff from the adjacent higher areas. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and the low soil temperature in spring.

This soil is suited to grasses and legumes for hay and pasture. However, management may be difficult because this soil is poorly drained and is subject to flooding. Forage species that tolerate wetness will help to maintain productivity. Drainage is needed for alfalfa crops. Diversions or terraces on adjacent soils on uplands and dikes or levees along major stream channels may be needed to protect this soil from flooding. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development, reduces production, and increases ponding. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland.

The land capability classification is IIw.

54+—Zook silt loam, overwash, 0 to 2 percent slopes. This nearly level, poorly drained soil is on bottom land along the major streams. It is subject to flooding. Areas are irregular in shape, and commonly range from 5 to 30 acres in size.

Typically, the surface layer is stratified, very dark gray, dark gray, and dark grayish brown, friable silt loam overwash sediment about 18 inches thick. Below this, the original surface layer is black, friable silty clay loam about 7 inches thick. The subsurface layer is black, firm silty clay. The subsoil extends to a depth of about 60 inches. It is black, firm silty clay in the upper part and very dark gray, firm silty clay in the lower part.

Permeability of this Zook soil is slow. Surface runoff is slow or very slow. The soil has a seasonal high water table at the surface or to a depth of 3 feet. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 2 to 4 percent in the surface layer. The subsoil has a medium supply of available phosphorus and a low supply of available potassium. This soil has fair tilth, but tends to puddle if worked when wet.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. In many years row crops can be grown if the soil is adequately drained and protected from floodwater. A drainage system is needed to reduce the wetness and to provide good aeration and a deep root zone for plants. Tile drains generally work satisfactorily only if they are closely spaced and if an adequate outlet is available. In some areas surface drains are needed to remove excess surface water. In many areas diversions are needed to protect the soil from the runoff from the adjacent higher areas. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and the low soil temperature in spring.

This soil is suited to grasses and legumes for hay and pasture. However, management may be difficult because this soil is poorly drained and is subject to flooding. Forage species that tolerate wetness will help to maintain productivity. Drainage is needed for alfalfa crops. Diversions or terraces on adjacent soils on uplands and dikes or levees along major stream channels may be needed to protect this soil from flooding. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development, reduces production, and increases ponding. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland.

The land capability classification is IIw.

56C—Cantril loam, 5 to 9 percent slopes. This moderately sloping, somewhat poorly drained soil is on concave foot slopes and alluvial fans. It is downslope from moderately steep to very steep soils that formed in glacial till. Areas are long and narrow, and they commonly range from 4 to 15 acres in size.

Typically, the surface layer is very dark gray and very dark grayish brown, friable loam about 7 inches thick. The subsurface layer is dark grayish brown, mottled, friable loam about 3 inches thick. The subsoil extends to a depth of about 60 inches or more. The upper part is grayish brown and yellowish brown, mottled, friable clay loam. The lower part is dark grayish brown, mottled, firm clay loam. In some places the subsoil has more clay.

Permeability of this Cantril soil is moderate. Surface runoff is medium. The soil has a seasonal high water table at a depth of 2 to 4 feet. Available water capacity is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has good tilth, but tends to puddle if worked when wet.

Many areas are cultivated. Some are used as pasture or woodland. This soil is moderately well suited to corn, soybeans, and small grains, and is well suited to grasses and legumes for hay and pasture. If cultivated crops are grown continuously, water erosion is a hazard. Water erosion can be adequately controlled in intensively row-cropped areas through a combination of soil conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, diversions, contour farming, grassed waterways, and a cropping rotation that includes grasses and legumes. Regular additions of organic material to the soil improve soil fertility, maintain good tilth, and increase the rate of water infiltration.

This soil is best suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of the pasture and hayland.

This soil is well suited to trees, and some areas remain in native hardwoods. New stands of trees survive and grow well if properly selected and managed.

The land capability classification is IIe.

65D—Lindley loam, 9 to 14 percent slopes. This strongly sloping, moderately well drained soil is on convex, valley side slopes on uplands. Areas are long and narrow, and commonly range from 5 to 15 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 3 inches thick. The subsurface layer is brown, friable loam about 7 inches thick. The subsoil is yellowish brown and about 35 inches thick. The upper part is firm clay loam; the next part is very firm clay; and the lower part is mottled, firm clay loam. The substratum to a depth of about 60 inches is light brownish gray and yellowish brown, firm, calcareous clay loam, and has an accumulation of lime. Stones and pebbles are in the subsoil and substratum. In some places the surface layer is 6 to 8 inches thick. Scattered stones and boulders have come to the surface through the processes of freezing, thawing, and heaving.

Included with this soil in mapping are small areas of the Keswick soils. These soils have more clay in the subsoil than the Lindley soil. These soils are on the upper part of the slope, and make up 5 to 10 percent of the map unit.

Permeability of this Lindley soil is moderately slow. Surface runoff is rapid. Available water capacity is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. This soil has fair tilth, and tends to puddle if worked when wet and to crust after hard rains. Germination and development of seedlings are retarded if crusting occurs prior to seedling emergence.

Most areas are used as woodland and pasture. This soil is poorly suited to intensive row cropping. It is moderately well suited to small grains and to grasses and legumes for hay and pasture. If row crops are grown, water erosion is a severe hazard. Erosion can be adequately controlled for occasional row crops through a combination of soil conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, contour farming, grassed waterways, and a cropping rotation that includes grasses and legumes. Conservation practices upslope that increase the rate of water infiltration and reduce runoff help to control erosion. Regular additions of organic material to the soil improve fertility, help to prevent surface crusting, increase the rate of water infiltration, and improve tilth.

This soil is best suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay is also effective in controlling water erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. In some places terraces and diversions may be needed to protect critically seeded areas.

This soil is well suited to trees, and many areas remain in native hardwoods. New stands of trees are easily planted and harvested if they are properly selected and managed.

This soil is well suited to use as habitat for woodland wildlife. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to the wooded areas help to maintain or improve the habitat.

The land capability classification is IVe.

65E—Lindley loam, 14 to 18 percent slopes. This moderately steep, moderately well drained soil is on convex nose slopes and valley side slopes on uplands. Areas are long and narrow, and commonly range from 5 to 30 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 3 inches thick. The subsurface layer is brown, friable loam about 5 inches thick. The subsoil is yellowish brown and about 32 inches thick. The upper part is firm clay loam; the next part is mottled, very firm clay; and the lower part is mottled, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm, calcareous clay loam. It has soft accumulations and nodules of lime. Stones and pebbles are in the subsoil and substratum. In some places the surface layer is 6 to 8 inches thick. Scattered stones and boulders have come to the surface through the processes of freezing, thawing, and heaving.

Included with this soil in mapping are small areas of the Keswick soils on the upper part of side slopes. These soils have more clay in the subsoil than the Lindley soil. These soils make up 5 to 10 percent of the map unit.

Permeability of this Lindley soil is moderately slow. Surface runoff is rapid. Available water capacity is high.

The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. This soil has fair tilth, and tends to puddle if worked when wet and to crust after hard rains. Germination and development of seedlings are retarded if crusting occurs prior to seedling emergence.

Most areas are used as woodland and pasture. This soil generally is unsuited to corn, soybeans, and small grains because of the slope and the severe hazard of water erosion. It is best suited to grasses and legumes for hay and pasture.

This soil is moderately well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay is effective in controlling water erosion. Operating farm machinery is difficult because of the slope, gullies, and waterways. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the water erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

This soil is moderately well suited to trees, and many areas remain in native hardwoods. The hazard of water erosion and equipment limitations are the main management concerns. Laying out the trails or roads on or nearly on the contour will help to control erosion. Because of the slope, operating logging equipment is somewhat hazardous. Special logging equipment and caution in its use are needed. In planting or harvesting trees, other limitations or hazards are slight.

This soil is suited to use as habitat for woodland wildlife. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas help to maintain or improve the habitat.

The land capability classification is VIe.

65F—Lindley loam, 18 to 25 percent slopes. This steep, moderately well drained soil is on convex, valley side slopes and nose slopes on uplands. This soil commonly is dissected by gullies and narrow V-shaped drains. Areas are long and narrow or irregularly shaped, and commonly range from 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 3 inches thick. The subsurface layer is dark grayish brown and brown, friable loam about 6 inches thick. The subsoil is about 35 inches thick. The upper part is yellowish brown, friable and firm clay loam. The next part is yellowish brown and strong brown, mottled, very firm clay. The lower part is yellowish brown and light brownish gray, mottled, firm, calcareous clay loam, and has nodules and specks of lime. The substratum to a depth of about 60 inches is light brownish gray and yellowish brown, mottled, firm, calcareous clay loam. It has soft accumulations and nodules of lime. Stones and pebbles are in the subsoil and substratum. In some places the surface layer is 6 to 8 inches thick. Scattered stones and boulders have come to the surface through the processes of freezing, thawing, and heaving. In some places the slopes are steeper.

Included with this soil in mapping are small areas of the Keswick soils on the upper part of side slopes. These soils contain more clay in the subsoil than the Lindley soil. These soils make up 5 to 10 percent of the map unit.

Permeability of this Lindley soil is moderately slow. Surface runoff is very rapid. Available water capacity is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. This soil has fair tilth, but tends to puddle if worked when wet and to crust after hard rains. Germination and development of seedlings are retarded if crusting occurs prior to seedling emergence.

Most areas are used as woodland or pasture. This soil is unsuited to corn, soybeans, and small grains and is poorly suited to hay production because of the slope and the severe water erosion hazard. Many areas have short, steep slopes, where the use of ordinary farm machinery is both difficult and dangerous. It is best suited to use as pasture, woodland, and wildlife habitat.

A cover of pasture plants is effective in controlling water erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance,

Figure 9.—Native hardwoods on Lindley loam, 18 to 25 percent slopes, provide firewood and wildlife habitat.

weed and brush control, and timely applications of lime help to improve the productivity of pasture. Pasture management is difficult because of the slope. When pasture is renovated, all cultural practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. Special equipment and caution in its use are needed.

This soil is moderately well suited to trees, and most areas remain in native hardwoods (fig. 9). The water erosion hazard and equipment limitations are the main management concerns. Laying out the trails or roads on or nearly on the contour will help to control erosion.

Because of the slope, operating logging equipment is both difficult and dangerous. Special logging equipment and caution in its use are needed. Other limitations or hazards that affect planting or harvesting trees are slight.

This soil is suited to use as habitat for woodland wildlife. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas help to maintain or improve the habitat.

The land capability classification is VIIe.

65F2—Lindley clay loam, 18 to 25 percent slopes, moderately eroded. This steep, moderately well drained soil is on convex valley side slopes and nose slopes on uplands. This soil commonly is dissected by gullies and narrow, V-shaped drains. Areas are long and narrow or irregularly shaped, and commonly range from 5 to 25 acres in size.

Typically, the surface layer is dark grayish brown, friable clay loam about 6 inches thick. It is mixed with streaks and pockets of yellowish brown subsoil material. The subsoil is yellowish brown about 34 inches thick. The upper part is firm clay loam; the next part is mottled, very firm clay; and the lower part is mottled, firm, calcareous clay loam. The substratum to a depth of about 60 inches is yellowish brown and light brownish gray, mottled, firm, calcareous clay loam. It has soft accumulations and nodules of lime. Stones and pebbles are on the surface and throughout the profile. In some places the surface layer is yellowish brown clay loam. Scattered boulders and stones have come to the surface through the processes of freezing, thawing, and heaving.

Included with this soil in mapping are small areas of the Keswick soils on the upper part of side slopes. These soils contain more clay in the subsoil than the Lindley soil. They make up 5 to 10 percent of the map unit.

Permeability of this Lindley soil is moderately slow. Surface runoff is very rapid. Available water capacity is high. The content of organic matter is about 1.5 to 2.5 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. This soil has poor tilth, and tends to puddle if worked when wet and to crust after hard rains. Germination and development of seedlings are retarded if crusting occurs prior to seedling emergence.

Most areas are used as pasture and woodland. Some areas have been cultivated at some time in the past. This soil is unsuited to corn, soybeans, and small grains, and is poorly suited to hay production because of the slope and the severe hazard of further water erosion. In many areas short, steep slopes make the use of ordinary farm machinery both difficult and dangerous. This soil is best suited to use as pasture, woodland, and wildlife habitat.

A cover of pasture plants is effective in controlling water erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture. Pasture management on this soil is difficult because of steepness of slope. When pasture is renovated, all cultural practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. Special equipment and caution in its use are needed.

This soil is moderately well suited to trees, and a few areas remain in native hardwoods. The hazard of water erosion and equipment limitations are the main management concerns. Laying out the trails or roads on the contour or nearly on the contour will help to control erosion. Because of the slope, operating logging equipment is both difficult and dangerous. Special logging equipment and caution in its use are needed. Seedlings do not survive well on this soil. Planting them at close intervals and then thinning the surviving trees help to achieve the desired stand density. Other limitations or hazards that affect planting or harvesting trees are slight.

This soil is suited to use as habitat for woodland wildlife. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas help maintain or improve the habitat.

The land capability classification is VIIe.

65G—Lindley loam, 25 to 40 percent slopes. This very steep, moderately well drained soil is on convex valley side slopes on uplands. This soil commonly is dissected by gullies and narrow V-shaped drains. Areas are long and narrow and generally are 5 to 25 acres in size.

Typically, the surface layer is very dark gray and very dark grayish brown, friable loam about 3 inches thick. The subsurface layer is brown and grayish brown, mottled, friable loam about 8 inches thick. The subsoil is about 45 inches thick. The upper part is yellowish brown, mottled, friable clay loam. The next part is yellowish brown and strong brown, mottled, very firm clay and clay loam. The lower part is yellowish brown, mottled, firm clay loam, and is calcareous in the lower part. The substratum to a depth of about 60 inches is light brownish gray, mottled, firm, calcareous clay loam. The calcareous part of the subsoil and substratum has soft accumulations and nodules of lime. Stones and pebbles are in the subsoil and substratum. Scattered stones and boulders have come to the surface through the processes of freezing, thawing, and heaving.

Permeability of this Lindley soil is moderately slow. Surface runoff is very rapid. Available water capacity is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. This soil has fair tilth, but generally is not tilled.

Most areas are woodland. Many areas remain in native hardwoods. This soil is best suited to trees. It is unsuited to cultivated crops or hay, and is poorly suited to pasture because of the slope and the severe hazard of water erosion.

This soil is moderately well suited to trees. The hazard of water erosion and equipment limitations are severe, and are major management concerns. Carefully selecting sites for logging trails or roads and laying out the trails or roads on or nearly on the contour help to control erosion. Because of the slope, operating logging equipment is very difficult and dangerous. Special logging equipment and caution in its use are needed. Other limitations or hazards that affect planting or harvesting trees are slight.

This soil is suited to use as habitat for woodland wildlife. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas help to maintain or improve the habitat.

The land capability classification is VIIe.

69C—Clearfield silty clay loam, 5 to 9 percent slopes. This moderately sloping, poorly drained soil is on short, convex side slopes and in coves at the heads of drainageways on uplands. Areas are long and narrow or irregularly shaped, and commonly range from 8 to 35 acres in size.

Typically, the surface layer is black, friable silty clay loam about 7 inches thick. The subsurface layer is black, mottled, friable silty clay loam about 5 inches thick. The subsoil is about 32 inches thick. The upper part is dark gray and dark grayish brown, mottled, firm silty clay loam. The next part is grayish brown, mottled, firm and friable silty clay loam. The lower part is light brownish gray, mottled, friable silty clay loam. The substratum is light olive gray, mottled, friable silty clay loam to a depth of about 50 inches. It is a buried gray, mottled, very firm silty clay paleosol to a depth of about 60 inches. In some places the buried, gray, clayey paleosol is at a depth of more than 60 inches. In some places the surface layer is mixed with streaks and pockets of dark gray or dark grayish brown subsoil material.

Included with this soil in mapping are small areas of Clarinda and Nira soils. The Clarinda soils formed in a thin mantle of loess and in the underlying exhumed, gray, clayey paleosol that weathered from glacial till. They are on the lower part of side slopes. They are more difficult to prepare as seedbeds, and are seepy and wet in spring. The Nira soils are moderately well drained, and are on convex ridges and side slopes on the landscape. These areas make up 10 to 15 percent of the map unit.

Permeability of this Clearfield soil is moderately slow in the upper loess material and very slow in the underlying paleosol. Surface runoff is medium. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium. This soil has fair tilth, but tends to puddle if worked when wet.

Many areas are used as pasture or hayland. Some areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grains. It is well suited to grasses and legumes for hay and pasture. If cultivated crops are grown continuously, erosion is a severe hazard. Because this soil is poorly drained, a combination of tile drainage and terraces works well to allow timelier field operations during wet springs and to control erosion. Erosion can be adequately controlled in intensively row-cropped areas through a combination of soil conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour stripcropping, contour farming, grassed waterways, grassed headlands, terracing, and a cropping rotation that includes grasses and legumes. If terraces are built, topsoil should be stockpiled and spread over the excavated and built-up areas to ease the restoration of productivity. Regular additions of organic material to the soil improve soil fertility, improve or maintain tilth, and increase the rate of water infiltration.

This soil is best suited to grasses and legumes for hay and pasture. A cover of hay or pasture plants helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation and interseeding practices, if done on the contour, help to control erosion and to save fuel. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

The land capability classification is IIIw.

69C2—Clearfield silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, poorly drained soil is on short, convex side slopes and in coves at the heads of drainageways on uplands. Areas are long and narrow or irregularly shaped, and commonly range from 5 to 30 acres in size.

Typically, the surface layer is black and very dark gray, friable silty clay loam about 8 inches thick. It is mixed with streaks and pockets of dark grayish brown subsoil material. The subsoil is about 34 inches thick. The upper part is dark grayish brown, mottled, firm silty clay loam. The next part is grayish brown, mottled, firm silty clay loam. The lower part is light brownish gray, mottled, friable silty clay loam. A gray, mottled, very firm silty clay paleosol is at a depth of about 42 inches, and extends to a depth of 60 inches or more. In some places the buried gray, clayey paleosol is at a depth of more than 60 inches. In some places the surface layer and subsurface layer are black or very dark gray silty clay loam 10 inches thick or more. In small severely eroded areas, the surface layer is mostly dark grayish brown or dark gray silty clay loam.

Included with this soil in mapping are small areas of Clarinda and Nira soils. The Clarinda soils formed in a thin mantle of loess and in the underlying exhumed, gray, clayey paleosol that weathered from glacial till. They are on the lower part of side slopes, and are seepy and wet in spring. The Nira soils are moderately well drained, and are on convex ridges and side slopes. These areas make up 10 to 15 percent of the map unit.

Permeability of this Clearfield soil is moderately slow in the upper loess material and very slow in the underlying paleosol. Surface runoff is medium. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium. This soil has fair tilth, and tends to puddle if worked when wet.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grains. It is well suited to grasses and legumes for hay and pasture. If cultivated crops are grown continuously, further erosion is a severe hazard. Because this soil is poorly drained, a combination of tile drainage and terraces works well to allow timelier field operations during wet springs and to control erosion. Erosion can be adequately controlled in intensively row-cropped areas through a combination of soil conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour stripcropping, contour farming, grassed waterways, grassed headlands, terracing, and a cropping rotation that includes grasses and legumes. If terraces are built, topsoil should be stockpiled and spread over the excavated and built-up areas to restore productivity. Regular additions of organic material to the soil improve soil fertility and tilth, and increase the rate of water infiltration. This soil generally needs more nitrogen than the uneroded Clearfield soils, and requires greater production inputs to maintain higher yields and to maintain or to improve tilth.

This soil is best suited to grasses and legumes for hay and pasture. A cover of pasture or hay plants is also effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation and interseeding practices, if done on the contour, help to control erosion and to save fuel. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard, and results in a minimum loss of grazing or hay production during the seeding year.

The land capability classification is IIIw.

76C2—Ladoga silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on convex ridgetops and shoulder slopes on the loess-covered uplands. Areas are long and narrow or irregularly shaped, and commonly range from 5 to 20 acres in size.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 7 inches thick. It is mixed with streaks and pockets of brown subsoil material. The subsoil is about 47 inches thick. The upper part is brown and dark yellowish brown, friable and firm silty clay loam. The next part is dark yellowish brown, firm silty clay. The lower part is yellowish brown and grayish brown, mottled, firm and friable silty clay loam. The substratum to a depth of about 60 inches is grayish brown, mottled, friable silty clay loam. In small severely eroded areas, the surface layer is mostly brown or dark yellowish brown silty clay loam. Also, in places the subsoil is grayish brown and contains less clay.

Permeability of this Ladoga soil is moderately slow. Surface runoff is medium. Available water capacity is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium. This soil has fair tilth, and tends to puddle if worked when wet.

Many areas are cultivated. Some areas are in pasture or woodland. This soil is moderately well suited to corn, soybeans, and small grains. It is well suited to grasses and legumes for hay and pasture. If cultivated crops are grown, soil erosion is a severe hazard. Erosion can be adequately controlled in intensively row-cropped areas through a combination of soil conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, grassed waterways, grassed headlands, contour stripcropping, contour farming, terracing, and a cropping rotation that includes grasses and legumes. If terraces are built, topsoil should be stockpiled and spread over the excavated and built-up areas to ease restoration of productivity. Regular additions of organic material to the soil improve soil fertility and tilth, and increase the rate of water infiltration. This soil generally needs more nitrogen than the uneroded Ladoga soil, and requires greater production inputs to maintain higher yields and to maintain or improve tilth.

This soil is best suited to grasses and legumes for hay and pasture. A cover of hay or pasture plants is also effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion and to save fuel. Interseeding the grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

This soil is well suited to trees. A few small areas remain in native hardwoods. New stands of trees survive and grow well if species are properly selected and managed.

The land capability classification is IIIe.

87B—Zook-Colo silty clay loams, 0 to 5 percent slopes. These nearly level and gently sloping, poorly drained soils are in narrow upland drainageways. They are subject to flooding. The Zook soil is in the nearly level parts of this map unit, and the Colo soil is along the stream channels. Areas are long and narrow, and commonly range from 10 to 75 acres in size. This map unit is about 60 percent Zook soil and 40 percent Colo soil. These soils occur as areas so intricately mixed or so small and narrow that mapping them separately is not practical.

Typically, the surface layer of the Zook soil is black, friable silty clay loam about 10 inches thick. The subsurface layer is about 26 inches thick and is black. The upper part is friable silty clay loam, and the lower part is firm silty clay. The subsoil is very dark gray and dark gray, very firm and firm silty clay about 22 inches thick. The substratum to a depth of about 60 inches is dark gray, firm silty clay. In some places the subsoil has more clay.

Typically, the surface layer of the Colo soil is black, friable silty clay loam about 9 inches thick. The subsurface layer is black, friable silty clay loam about 26 inches thick. The subsoil is mottled, friable silty clay loam about 22 inches thick. The upper part is very dark gray, and the lower part is gray. The substratum to a depth of about 60 inches is gray, mottled, friable silty clay loam.

Permeability is slow in the Zook soil and moderate in the Colo soil. Surface runoff is slow. Available water capacity is high in both soils. The Colo soil has a seasonal high water table at a depth of 1 to 3 feet. The Zook soil has a seasonal high water table at the surface or to a depth of 3 feet, and has a high shrink-swell potential. The content of organic matter is about 5 to 7 percent in the surface layer of both soils. The supply of available phosphorus is low in the Zook soil and is medium in the Colo soil. The supply of available potassium is low in the Zook soil and is very low in the Colo soil. Both soils have fair tilth, and tend to puddle if worked when wet.

These soils are used mainly for cultivated crops and as pasture. In most areas they are managed along with adjacent soils. They are moderately well suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. In many years row crops can be grown if the soil is adequately drained and protected from floodwater. A subsurface drainage system is needed to lower the seasonal high water table and to provide proper aeration and a deep root zone for plants. Tile drains work satisfactorily. In some places diversions can help to control excess runoff from adjacent upslope areas. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and the low soil temperature in spring.

These soils are best suited to grasses and legumes for hay and pasture. Overgrazing or grazing when these soils are too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland.

The land capability classification is IIw.

93D—Shelby-Adair loams, 9 to 14 percent slopes. These strongly sloping soils are on short, convex side slopes, narrow, convex ridgetops, and convex nose slopes on uplands. The moderately well drained Shelby soil is on the lower part of slopes, and the moderately well drained and somewhat poorly drained Adair soil is on the upper part of slopes. Individual areas are long and narrow or irregularly shaped, and commonly range from 5 to 15 acres in size. They are about 65 percent Shelby soil and 35 percent Adair soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the surface layer of the Shelby soil is very dark brown, friable loam about 9 inches thick. The subsurface layer is dark brown, friable clay loam about 6 inches thick. The subsoil to a depth of about 60 inches is firm clay loam. The upper part is brown and dark yellowish brown, the next part is yellowish brown and mottled, and the lower part is strong brown and light brownish gray and mottled. Pebbles and stones are in the subsoil and substratum. In some places the surface layer is mixed with streaks and pockets of brown subsoil material.

Typically, the surface layer of the Adair soil is black, friable loam about 8 inches thick. The subsurface layer is very dark gray, friable clay loam about 3 inches thick. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is very dark grayish brown and brown, firm clay loam. The next part is yellowish red, very firm clay. The lower part is yellowish brown and strong brown, very firm and firm clay and clay loam. In some places the surface layer is mixed with streaks and pockets of brown subsoil material.

Permeability is moderately slow in the Shelby soil and slow in the Adair soil. Surface runoff on both soils is rapid. Available water capacity is high. The Adair soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high in the Adair soil. The content of organic matter is about 3 to 4 percent in the surface layer of both soils. In both soils the subsoil generally has a very low supply of available phosphorus and potassium. The soils in this map unit have good tilth, but tend to puddle if worked when wet.

Many areas are used for hay and pasture. Some areas are cultivated. In most areas the soils in this map unit are managed along with adjacent soils. They are moderately well suited to occasional row crops grown in rotation with small grains and to legumes for hay. They are well suited to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a severe hazard. Erosion can be adequately controlled through a combination of soil conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, grassed waterways, contour stripcropping, contour farming, terracing, and a cropping rotation that includes grasses and legumes. Conservation practices upslope that increase the rate of water infiltration and reduce runoff will also help to control erosion on this map unit. Regular additions of organic material to these soils improve soil fertility, maintain good tilth, and increase the rate of water infiltration.

These soils are best suited to grasses and legumes for hay and pasture. A cover of hay or pasture plants is also effective in controlling soil erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and these soils in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. In some places terraces and diversions may be needed to protect critically seeded areas.

The land capability classification is IVe.

93D2—Shelby-Adair clay loams, 9 to 14 percent slopes, moderately eroded. These strongly sloping soils are on short, convex side slopes, narrow, convex ridgetops, and convex nose slopes on uplands. The moderately well drained Shelby soil is on the lower part of slopes, and the moderately well drained and somewhat poorly drained Adair soil is on the upper part of slopes. Individual areas are long and narrow or irregularly shaped, and commonly range from 5 to 30 acres in size. They are about 60 percent Shelby soil and 40 percent Adair soil. The two soils are in areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Shelby soil is very dark brown, friable clay loam about 8 inches thick. It is mixed with streaks and pockets of dark yellowish brown subsoil material. The subsoil is about 38 inches thick, and is firm clay loam. The upper part is dark yellowish brown, the next part is yellowish brown and mottled, and the lower part is yellowish brown and light brownish gray and mottled. The substratum to a depth of about 60 inches is light brownish gray, mottled, firm clay loam. Pebbles and stones are in the subsoil and substratum. In some places the surface layer and subsurface layer are 10 inches thick or more.

Typically, the surface layer of the Adair soil is very dark gray, friable clay loam about 8 inches thick. It is mixed with streaks and pockets of brown clay loam subsoil material. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is brown and strong brown, very firm clay. The next part is yellowish red and gray, very firm clay. The lower part is yellowish brown and light brownish gray, firm clay loam.

Permeability is moderately slow in the Shelby soil and slow in the Adair soil. Surface runoff on both soils is rapid. Available water capacity is high. The Adair soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high in the Adair soil. The content of organic matter is about 2 to 3 percent in the surface layer of both soils. The subsoil of Shelby and Adair soils generally has a very low supply of available phosphorus and potassium. Both soils have fair tilth, and tend to puddle if worked when wet.

Most areas are cultivated. In most areas the soils in this map unit are managed along with adjacent soils. These soils are fairly suited to row crops and are moderately well suited to small grains. They are well suited to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a severe hazard. Water erosion can be adequately controlled for occasional row crops through a combination of soil conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed waterways, terracing, and a cropping rotation that includes grasses and legumes. Conservation practices upslope that increase the rate of water infiltration and reduce runoff will also help to control erosion on this map unit. Regular additions of organic material to these soils improve soil fertility and tilth and increase the rate of water infiltration. These soils generally need more nitrogen than the uneroded Shelby-Adair loams, and require greater production inputs to maintain high yields and to maintain or improve tilth.

The soils in this map unit are best suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay is also effective in controlling water erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soils in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. In some places terraces and diversions may be needed to protect critically seeded areas.

The land capability classification is IVe.

93D3—Shelby-Adair clay loams, 9 to 14 percent slopes, severely eroded. These strongly sloping soils are on short, convex side slopes, narrow, convex ridgetops, and convex nose slopes on uplands. The moderately well drained Shelby soil is on the lower part of the slope, and the moderately well drained and somewhat poorly drained Adair soil is on the upper part. Individual areas are long and narrow or irregularly shaped, and commonly range from 5 to 20 acres in size. They are about 50 percent Shelby soil and 50 percent Adair soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Shelby soil is dark yellowish brown, friable clay loam about 6 inches thick. It is mixed with 20 to 25 percent streaks and pockets of very dark brown loam material from the original surface layer. The subsoil is mottled, firm clay loam about 36 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The substratum to a depth of about 60 inches is yellowish brown and light brownish gray, mottled, firm clay loam. Pebbles and stones are scattered on the surface and in the subsoil and substratum. In some places the surface layer is mostly very dark brown, friable clay loam about 8 inches thick.

Typically, the surface layer of the Adair soil is brown, firm clay loam about 7 inches thick. It is mixed with 20 to 25 percent streaks and pockets of very dark gray material from the original surface layer. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is red, brown, and yellowish red, very firm clay. The next part is strong brown and gray, very firm clay. The lower part is yellowish brown and light brownish gray, firm clay loam. Stones and pebbles are scattered on the surface and in the subsoil and substratum. In some places the surface layer is mostly very dark gray, friable clay loam about 8 inches thick.

Permeability is moderately slow in the Shelby soil and slow in the Adair soil. Surface runoff on both soils is rapid. The available water capacity of both soils is high. The Adair soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high in the Adair soil. The content of organic matter is about 1 to 3 percent in the surface layer of both soils. In both soils the subsoil generally has a very low supply of available phosphorus and potassium. Both soils have poor tilth, and tend to puddle if worked when wet.

Some areas are cultivated. Almost all areas have been cultivated in the past. Many areas are now used for hay and pasture. In most areas these soils are managed along with the adjacent soils. Because of the slope and the severe hazard of erosion, these soils generally are unsuited to row crops. They are fairly suited to small grains, and are moderately well suited to grasses and legumes for hay and pasture. If row crops are grown, further soil erosion is a severe hazard. Erosion can be adequately controlled for an occasional year of row crops through a combination of soil conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour stripcropping, grassed waterways, and a cropping rotation that includes grasses and legumes. Regular additions of organic material to these soils improve soil fertility and tilth and increase the rate of water infiltration.

This map unit is best suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soils in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

The land capability classification is VIe.

94D—Caleb-Mystic loams, 9 to 14 percent slopes. These strongly sloping soils are on convex ridgetops and side slopes of high stream terraces. The moderately well drained Caleb soil generally is on the lower part of the slope. The moderately well drained and somewhat poorly drained Mystic soil is on the upper part of the slope. Individual areas are long, narrow, and irregularly shaped, and commonly range from 5 to 25 acres in size. They are about 70 percent Caleb soil and 30 percent Mystic soil. The two soils occur as areas so intricately mixed or so small and narrow that mapping them separately is not practical.

Typically, the surface layer of the Caleb soil is very dark grayish brown, friable loam about 7 inches thick. The subsurface layer is brown and yellowish brown, friable loam about 5 inches thick. The subsoil is about 36 inches thick. The upper part is dark yellowish brown, friable and firm clay loam. The next part is yellowish brown, firm clay loam. The lower part is yellowish brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, friable sandy clay loam and loam. In some places the surface layer is mixed with streaks and pockets of brown and dark yellowish brown clay loam subsoil material. In other small areas the surface layer is silt loam.

Typically, the surface layer of the Mystic soil is very dark grayish brown, friable loam about 8 inches thick. The subsurface layer is dark grayish brown and yellowish brown, friable loam about 4 inches thick. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is yellowish brown, friable and firm clay loam. The next part is yellowish brown and light brownish gray, very firm clay. The lower part is light brownish gray and strong brown, firm clay loam and sandy clay loam. In some places the surface layer is mixed with streaks and pockets of brown and yellowish brown clay loam subsoil material. In other small areas the surface layer is silt loam.

Permeability is moderate in the Caleb soil and slow in the Mystic soil. Surface runoff on both soils is rapid. In both soils the available water capacity is high and the seasonal high water table is at a depth of 3 to 5 feet. The shrink-swell potential is high in the Mystic soil. In both soils the content of organic matter is about 2.5 to 3.5 percent in the surface layer. The subsoil of both Caleb and Mystic soils generally has a very low supply of available phosphorus and a low supply of available potassium. These soils have fair tilth, and tend to puddle if worked when wet and to crust after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Many areas are in pasture and hayland. Some areas are cultivated. These soils are poorly suited to corn and soybeans. They are moderately well suited to small grains and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a severe hazard. Erosion can be adequately controlled for occasional row crops through a combination of soil conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed waterways, and a cropping rotation that includes grasses and legumes. Conservation practices upslope that increase the rate of water infiltration and reduce runoff will help to control erosion on these soils. Regular additions of organic material and deferring tillage when the soils are wet help to maintain or improve tilth and fertility, to reduce crusting, and to increase the rate of water infiltration.

These soils are best suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay also helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and these soils in good condition. Management may be difficult during periods when the Mystic soil is wet and seepy. Forage species that tolerate wetness will help to maintain productivity. Proper tile drainage placement on adjacent soils above the seep line will also help legume crops for hay as well as grasses for pasture. In addition, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. In some places terraces or diversions may be needed to protect critically seeded areas.

These soils are well suited to trees, and a few small areas remain in native hardwoods. New stands of trees survive and grow well if species are properly selected and managed.

The land capability classification of these soils is IVe.

94D2—Caleb-Mystic complex, 9 to 14 percent slopes, moderately eroded. These strongly sloping soils are on convex ridgetops and side slopes of high stream terraces. The moderately well drained Caleb soil generally is on the lower part of the slope. The moderately well drained and somewhat poorly drained Mystic soil is on the upper part of the slope. Individual areas are long, narrow, and irregularly shaped, and commonly range from 4 to 24 acres in size. They are 60 percent Caleb soil and 40 percent Mystic soil. The two soils occur as areas so intricately mixed or so small and narrow that mapping them separately is not practical.

Typically, the surface layer of the Caleb soil is very dark grayish brown, friable loam about 8 inches thick. It is mixed with streaks and pockets of brown clay loam subsoil material. The subsoil is about 45 inches thick. The upper part is brown and dark yellowish brown, friable clay loam. The lower part is yellowish brown, mottled, friable clay loam and sandy clay loam. The substratum to a depth of about 72 inches is yellowish brown, mottled, firm and friable clay loam, loam, and silt loam. In small severely eroded areas, the surface layer is mostly brown clay loam.

Typically, the surface layer of the Mystic soil is very dark grayish brown, friable clay loam about 7 inches thick. It is mixed with streaks and pockets of brown clay loam subsoil material. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is brown and grayish brown, firm clay loam. The next part is grayish brown and red, very firm clay. The lower part is strong brown and yellowish brown, firm clay loam and sandy clay loam. In some small severely eroded areas, the surface layer is mostly brown clay loam.

Permeability is moderate in the Caleb soil and slow in the Mystic soil. On both soils surface runoff is rapid. In both soils the available water capacity is high and the seasonal high water table is at a depth of 3 to 5 feet. The shrink-swell potential is high in the Mystic soil. In both soils the content of organic matter is about 2 to 3 percent in the surface layer. The subsoil of the Caleb and Mystic soils generally has a very low supply of available phosphorous and a low supply of available potassium. These soils have fair tilth, and tend to puddle if worked when wet and to crust after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Most areas are used for cultivated crops, hay, and pasture. These soils are poorly suited to corn and soybeans. They are moderately well suited to small grains and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a severe hazard. Water erosion can be adequately controlled for occasional row crops through a combination of soil conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed waterways, and a cropping rotation that includes grasses and legumes. Conservation practices upslope that increase the rate of water infiltration and reduce runoff will help to control water erosion on these soils. Adding organic material and deferring tillage when the soils are wet help to maintain or improve tilth and fertility, to reduce crusting, and to increase the rate of water infiltration. These soils generally need more nitrogen than the uneroded Caleb-Mystic loams, and greater production inputs are required to maintain higher yields and to maintain or improve tilth.

These soils are best suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay also helps to control water erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and these soils in good condition. Management may be difficult during periods when the Mystic soil is wet and seepy. Forage species that tolerate wetness will help to maintain productivity. Proper tile drainage placement on adjacent soils above the seep line will also help legume crops for hay and grasses for pasture. In addition, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. In some places terraces or diversions may be needed to protect critically seeded areas.

These soils are well suited to trees. New stands of trees survive and grow well if species are properly selected and managed.

The land capability classification of these soils is IVe.

94E2—Caleb-Mystic complex, 14 to 18 percent slopes, moderately eroded. These moderately steep soils are on side slopes and convex ridgetops of high stream terraces. The moderately well drained Caleb soil generally is on the lower part of the slopes. The moderately well drained and somewhat poorly drained Mystic soil is on the upper part of the slope. Individual areas are long, narrow, and irregular in shape, and commonly range from 4 to 20 acres in size. They are 60 percent Caleb soil and 40 percent Mystic soil. The two soils occur as areas so intricately mixed or so small and narrow that mapping them separately is not practical.

Typically, the surface layer of the Caleb soil is very dark grayish brown, friable loam about 7 inches thick. It is mixed with streaks and pockets of brown clay loam subsoil material. The subsoil is about 39 inches thick, and is mottled. The upper part is brown and yellowish brown, friable clay loam. The next part is yellowish brown, firm clay loam and sandy clay loam. The lower part is yellowish brown, friable clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, friable loam. In small severely eroded areas, the surface layer is mostly brown clay loam.

Typically, the surface layer of the Mystic soil is very dark grayish brown, friable clay loam about 7 inches thick. It is mixed with streaks and pockets of brown clay loam subsoil material. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is brown and grayish brown, firm clay loam. The next part is grayish brown and red, very firm clay. The lower part is strong brown and yellowish brown, firm clay loam and sandy clay loam. In small severely eroded areas, the surface layer is mostly brown clay loam.

Permeability is moderate in the Caleb soil and slow in the Mystic soil. Surface runoff on both soils is rapid. In both soils the available water capacity is high, and the seasonal high water table is at a depth of 3 to 5 feet. The shrink-swell potential is high in the Mystic soil. In both soils the content of organic matter is about 2 to 3 percent in the surface layer. The subsoil of the Caleb and Mystic soils generally has a very low supply of available phosphorus and a low supply of available potassium. These soils have fair tilth, and tend to puddle if worked when wet and to crust after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Most areas are used for hay and pasture. Some areas are cultivated. Most areas have been cultivated at some time in the past. These soils generally are not suited to corn, soybeans, and small grains because of the slope and the severe hazard of further erosion. They are best suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay also helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and these soils in good condition. In addition, suitable forage selection, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. In some places terraces and diversions may be needed to protect critically seeded areas.

This map unit is moderately well suited to trees. The hazard of erosion and the equipment limitation are the main management concerns. Laying out the trails or roads on or nearly on the contour will help to control erosion. Because of the slope, operating logging equipment is somewhat hazardous. Special logging equipment and caution in its use are needed. Other limitations or hazards that affect planting or harvesting trees are slight.

The land capability classification of these soils is VIe.

131B—Pershing silt loam, 2 to 5 percent slopes. This gently sloping, moderately well drained and somewhat poorly drained soil is on narrow convex ridgetops and short convex side slopes on uplands. Areas are irregularly shaped or long and narrow, and range from 5 to 30 or more acres in size.

Typically, the surface layer is very dark gray and very dark grayish brown, friable silt loam about 7 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is brown and yellowish brown, mottled, friable and firm silty clay loam. The next part is dark grayish brown, grayish brown, and light brownish gray, mottled, very firm and firm silty clay. The lower part is light brownish gray and light olive gray, mottled, firm and friable silty clay loam.

Included with this soil in mapping are small areas of poorly drained soils on the less sloping part of the landscape. These areas make up about 10 percent of the map unit.

Permeability of this Pershing soil is slow. Surface runoff is slow. Available water capacity is high. This soil has a seasonal high water table at a depth of 2 to 4 feet. The shrink-swell potential is high. The content of organic matter is about 2.5 to 3.5 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. This soil has good tilth, but tends to crust after heavy rains and to puddle if worked when wet. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Most areas are cultivated or used for hay and pasture. This soil is moderately well suited to corn, soybeans, and small grains. It is well suited to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. Erosion can be adequately controlled in intensively row-cropped areas through a combination of soil conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed headlands, a cropping rotation that includes grasses and legumes, and terraces. If terraces are built, cuts should be held to a minimum depth to avoid exposure of the clayey subsoil, or topsoil should be stockpiled and spread over the excavated and built-up areas to ease the restoration of productivity. Grassed waterways help to prevent gully erosion. Regular additions of organic material to the soil improve fertility, help to maintain good tilth, help to prevent crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

This soil is moderately well suited to trees, and a few areas remain in native hardwoods. Seedling mortality and the windthrow hazard are the main management concerns. Seedlings should be planted at close intervals because they do not survive well. The surviving trees can then be thinned later to achieve the desired stand density. Silvicultural practices that do not leave widely spaced individual trees will reduce the windthrow hazard. Other hazards or limitations that affect planting or harvesting trees are slight.

The land capability classification is IIIe.

131C—Pershing silt loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained and somewhat poorly drained soil is on narrow, convex ridgetops and short, convex side slopes on uplands. Areas are long and narrow or irregular in shape, and commonly range from 5 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 brown, friable silt loam about 5 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is yellowish brown, friable silty clay loam. The next part is grayish brown and yellowish brown, mottled, very firm and firm silty clay. The lower part is grayish brown and light brownish gray, mottled, firm and friable silty clay loam. In some places the surface layer is mixed with streaks and pockets of brown and yellowish brown silty clay loam subsoil material. In other places the surface layer is very dark gray silt loam. Some places are gently sloping.

Included with this soil in mapping are small areas of Armstrong and Bucknell soils on the lower part of side slopes. These soils contain more clay in the subsoil than the Pershing soil, and can be seepy during wet periods. They make up 5 to 10 percent of the map unit.

Permeability of this Pershing soil is slow. Surface runoff is medium. Available water capacity is high. The soil has a seasonal high water table at a depth of 2 to 4 feet. The shrink-swell potential is high. The content of organic matter is about 2.5 to 3.5 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. This soil has good tilth, but tends to crust after hard rains and to puddle if worked when wet. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Many areas are used for hay and pasture. Some areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grains. It is well suited to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. Water erosion can be adequately controlled in intensively row-cropped areas through a combination of conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed headlands, a cropping rotation that includes grasses and legumes, and terraces. If terraces are built, cuts should be held to a minimum depth to avoid exposure of the clayey subsoil, or topsoil should be stockpiled and spread over excavated and built-up areas to ease restoration of productivity. Grassed waterways help to prevent gully erosion. Regular additions of organic material to the soil improve fertility, help to maintain or improve tilth, help to prevent crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay helps to control water erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

This soil is moderately well suited to trees, and a few areas remain in native hardwoods. Seedling mortality and the windthrow hazard are the main management concerns. Seedlings should be planted at close intervals because they do not survive well. The surviving trees can then be thinned later to achieve the desired stand density. Silvicultural practices that do not leave widely spaced, individual trees will reduce the windthrow hazard. Other hazards or limitations that affect planting or harvesting trees are slight.

The land capability classification is IIIe.

131C2—Pershing silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained and somewhat poorly drained soil is on narrow, convex ridgetops and short, convex side slopes on uplands. Areas are long and narrow or irregular in shape, and commonly range from 5 to 120 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 7 inches thick. It is mixed with streaks and pockets of brown subsoil material. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is brown, friable silty clay loam. The next part is dark grayish brown and grayish brown, very firm and firm silty clay. The lower part is light brownish gray, friable silty clay loam. In some small severely eroded areas, the surface layer is mostly brown, firm silty clay loam.

Included with this soil in mapping are small areas of Armstrong and Bucknell soils on the lower part of side slopes. These soils contain more clay in the subsoil than the Pershing soil, and can be seepy during wet periods. They make up 5 to 10 percent of the map unit.

Permeability of this Pershing soil is slow. Surface runoff is medium. Available water capacity is high. The soil has a seasonal high water table at a depth of 2 to 4 feet. The content of organic matter is about 2 to 3 percent in the surface layer. The shrink-swell potential is high. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. This soil has fair tilth, and tends to crust after hard rains and to puddle if worked when wet. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Most areas are cultivated or used for hay and pasture. This soil is moderately well suited to corn, soybeans, and small grains. It is well suited to grasses and legumes for hay and pasture. If cultivated crops are grown, further soil erosion is a severe hazard. Erosion can be adequately controlled in intensively row-cropped areas by a combination of conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed headlands, a cropping rotation that includes grasses and legumes, and terraces. If terraces are built, cuts should be held to a minimum depth to avoid exposure of the clayey subsoil, or topsoil should be stockpiled and spread over the excavated and built-up areas to ease restoration of productivity. Grassed waterways help to prevent gully erosion. Regular additions of organic material to the soil improve fertility, help maintain or improve tilth, help to reduce crusting, and increase the rate of water infiltration. This soil generally needs more nitrogen than the uneroded Pershing soil, and greater production inputs are required to maintain higher yields and to maintain or improve tilth.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

This soil is moderately well suited to trees, and a few areas remain in native hardwoods. Seedling mortality and the windthrow hazard are the main management concerns. Seedlings should be planted at close intervals because they do not survive well. The surviving trees can then be thinned later to achieve the desired stand density. Silvicultural practices that do not leave widely spaced individual trees will reduce the windthrow hazard. Other hazards or limitations that affect planting or harvesting trees are slight.

The land capability classification is IIIe.

132C—Weller silt loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on narrow, convex ridgetops and short, convex side slopes on uplands. Areas are long and narrow or irregularly shaped, and commonly range from 5 to 60 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 3 inches thick. The subsurface layer is dark grayish brown and brown, friable silt loam about 6 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is yellowish brown, mottled, friable silt loam and silty clay loam. The next part is yellowish brown and brown, mottled, very firm and firm silty clay. The lower part is grayish brown, yellowish brown, and light brownish gray, mottled, friable silty clay loam. Some places are gently sloping. In some places the surface layer is dark grayish brown and brown silty clay loam.

Included with this soil in mapping are small areas of the Keswick soils on the lower part of side slopes. The subsoil of Keswick soils contains more clay than that of the Weller soil. These soils make up 5 to 10 percent of the map unit.

Permeability of this Weller soil is slow. Surface runoff is medium. Available water capacity is high. The soil has a seasonal high water table at a depth of 2 to 4 feet. The shrink-swell potential is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. This soil has fair tilth, and tends to puddle if worked when wet. It crusts after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Most areas are used for pasture or woodland. Some areas are cultivated. This soil is moderately well suited to occasional row crops. It is moderately well suited to small grains and to grasses and legumes for hay and pasture. If cultivated crops are grown, soil erosion is a severe hazard. Erosion can be adequately controlled for occasional row crops through a combination of conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, contour farming, contour stripcropping, winter cover crops, a cropping rotation that includes grasses and legumes, and terraces. In places, however, contour farming or terracing is difficult because of irregular or short slopes. If terraces are built, cuts should be held to a minimum depth to avoid exposure of the clayey subsoil, or topsoil should be stockpiled and spread over the excavated and built-up areas to ease restoration of productivity. Grassed waterways help to prevent gully erosion. Regular additions of organic material to the soil help to improve fertility and tilth, help to reduce crusting, and increase the rate of water infiltration.

This soil is best suited to grasses and legumes for hay and pasture (fig. 10). A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

This soil is moderately well suited to trees, and many areas remain in native hardwoods. Seedling mortality and the windthrow hazard are the main management concerns. Seedlings should be planted at close intervals because they do not survive well. The surviving trees can then be thinned later to achieve the desired stand density. Silvicultural practices that do not leave widely spaced, individual trees will reduce the windthrow hazard. Other hazards or limitations that affect planting or harvesting trees are slight.

This soil is well suited to use as habitat for woodland wildlife. Excluding livestock from wooded areas, planting trees and shrubs, constructing water impoundments, and establishing food plots adjacent to wooded areas help to maintain or improve the habitat.

The land capability classification is IIIe.

133—Colo silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on bottom land. It is subject to flooding. Areas are long and narrow or irregularly shaped, and commonly range from 5 to 40 acres or more in size.

Typically, the surface layer is black, friable silty clay loam about 9 inches thick. The subsurface layer is black, friable silty clay loam about 26 inches thick. The subsoil is mottled, friable silty clay loam about 22 inches thick. The upper part is very dark gray, and the lower part is gray. The substratum to a depth of about 60 inches is gray, mottled, friable silty clay loam. In

Figure 10.—An area of Weller silt loam, 5 to 9 percent slopes, used for pasture. The Keswick and Lindley soils are on side slopes.

some places an overwash of very dark grayish brown silt loam is on the surface.

Included with this soil in mapping are small areas of Zook soils. The Zook soils are slightly lower in the landscape, contain more clay, and are more difficult to drain than the Colo soil. These areas make up 10 to 15 percent of the map unit.

Permeability of this Colo soil is moderate. Surface runoff is slow. Available water capacity is high. This soil has a seasonal high water table at a depth of 1 to 3 feet. The content of organic matter is about 5 to 7 percent in the surface layer. The lower part of the subsurface layer and the subsoil generally have a medium supply of available phosphorus and a very low supply of available potassium. This soil has good tilth.

Most areas are cultivated. Some areas are used for pasture and hayland. This soil is well suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. In many years row crops can be grown if the soil is adequately drained and protected from floodwater. A subsurface drainage system is needed to reduce wetness and to provide good aeration and a deep root zone for plants. In some areas surface drains are needed to remove excess surface water. In many areas diversion terraces are needed to protect the soil from runoff from the higher surrounding areas. A ridge-till planting system, in which the soil is ridged and row crops are planted on ridges, helps to overcome the wetness and the low soil temperature in spring.

This soil is best suited to grasses and legumes for hay and pasture. Permanent pasture can be improved by renovating and reseeding with suitable forage species. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, impairs tilth, and reduces forage production. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland.

The land capability classification is IIw.

133B—Colo silty clay loam, 2 to 5 percent slopes. This gently sloping, poorly drained soil is at the base of upland, concave foot slopes and in upland drainageways. It is subject to flooding. Areas are long and narrow or irregularly shaped, and commonly range from 5 to 30 acres or more in size.

Typically, the surface layer is black, friable silty clay loam about 9 inches thick. The subsurface layer is black, friable silty clay loam about 26 inches thick. The subsoil is mottled, friable silty clay loam about 22 inches thick. The upper part is very dark gray, and the lower part is gray. The substratum to a depth of about 60 inches is gray, mottled, friable silty clay loam.

Included with this soil in mapping are small areas of the Olmitz soils. These soils contain more sand and do not require artificial drainage. The Olmitz soils are slightly higher in the landscape than the Colo soil, and make up 5 to 10 percent of the map unit.

Permeability of this Colo soil is moderate. Surface runoff is slow. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The content of organic matter is about 5 to 7 percent in the surface layer. The lower part of the subsurface layer and the subsoil generally have a medium supply of available phosphorus and a very low supply of available potassium. This soil has good tilth.

Many areas are cultivated. Some areas are used for hay and pasture. In most areas this soil is managed along with adjacent soils. This soil is well suited to corn, soybeans, and small grains, and to grasses and legumes for hay and pasture. In many years row crops can be grown if the soil is adequately drained and protected from floodwater. A subsurface drainage system is needed to lower the seasonal high water table and to provide good aeration and a deep root zone for plants. In many areas diversion terraces are needed to protect the soil from runoff from the higher surrounding areas. A ridge-till planting system, in which the soil is ridged and row crops are planted on ridges, helps to overcome the wetness and the low soil temperature in spring.

This soil is best suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, impairs tilth, and reduces forage production. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland.

The land capability classification is IIw.

179D—Gara loam, 9 to 14 percent slopes. This strongly sloping, moderately well drained soil is on narrow, convex ridgetops and nose slopes on uplands. Areas are long and narrow, and commonly range from 3 to 15 acres or more in size.

Typically, the surface layer is very dark gray, friable loam about 8 inches thick. The subsurface layer is dark grayish brown, friable loam about 4 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is dark yellowish brown, friable clay loam. The next part is yellowish brown, mottled, very firm clay. The lower part is grayish brown and yellowish brown, mottled, firm, calcareous clay loam, and has accumulations of lime. Stones and pebbles are in the subsoil. Scattered stones and boulders have come to the surface through the processes of freezing, thawing, and heaving. In some places the surface layer is mixed with streaks and pockets of dark yellowish brown clay loam subsoil material.

Included with this soil in mapping are small areas of the Armstrong soils on the upper part of slopes. The Armstrong soils contain more clay in the subsoil, and typically are more poorly drained than the Gara soil. They make up about 5 percent of the map unit.

Permeability of this Gara soil is moderately slow. Surface runoff is rapid. Available water capacity is high. The content of organic matter is about 2.5 to 3.5 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. This soil has good tilth, but tends to puddle if worked when wet. It crusts after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Most areas are used for hay and pasture, but some areas are cultivated. In most areas this soil is managed along with the adjacent soils. It is fairly suited to corn and soybeans, and is moderately well suited to small grains. If cultivated crops are grown, erosion is a severe hazard. Erosion can be adequately controlled for occasional row crops through a combination of conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, grassed waterways, contour farming, contour stripcropping, terraces, and a cropping rotation that includes grasses and legumes. Conservation practices upslope that increase the rate of water infiltration and reduce runoff will also help to control erosion on this soil. Leaving crop residue on the surface or regularly adding other organic material to the soil helps to maintain or improve fertility and tilth, helps to prevent crusting, and increases the rate of water infiltration.

This soil is moderately well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. Terraces and diversions may be needed to protect critically seeded areas.

This soil is well suited to trees, and some areas remain in native hardwoods. No particular problems should be encountered in harvesting or planting new stands of trees if species are properly selected and managed.

This soil is well suited to use as habitat for woodland wildlife. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas help to maintain or improve the habitat.

The land capability classification is IVe.

179D2—Gara clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on narrow, convex ridgetops, nose slopes, and valley side slopes on uplands. Areas are long and narrow, and commonly range from 3 to 15 acres or more in size.

Typically, the surface layer is very dark grayish brown, friable clay loam about 8 inches thick. It is mixed with streaks and pockets of dark yellowish brown subsoil material. The subsoil is about 38 inches thick. The upper part is dark yellowish brown, mottled, firm clay loam. The next part is yellowish brown, mottled, very firm clay. The lower part is grayish brown and yellowish brown, mottled, firm, calcareous clay loam, and has accumulations of lime. The substratum to a depth of about 60 inches is light brownish gray and yellowish brown, mottled, firm, calcareous clay loam, and has accumulations of lime. Stone and pebbles are in the subsoil and substratum. Scattered stones and boulders have come to the surface through the processes of freezing, thawing, and heaving. In some places the surface layer is very dark gray loam about 8 inches thick and the subsurface layer is dark grayish brown loam about 4 inches thick. In some small severely eroded areas, the surface layer is mostly dark yellowish brown clay loam.

Included with this soil in mapping are small areas of the Armstrong soils on the upper part of slopes. The Armstrong soils contain more clay in the subsoil, and typically are not as well drained as the Gara soil. They make up 5 to 10 percent of the map unit.

Permeability of this Gara soil is moderately slow. Surface runoff is rapid. Available water capacity is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. This soil has fair tilth, and tends to puddle if worked when wet. It crusts after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Most areas are used for hay and pasture, but some areas are cultivated. In most areas this soil is managed along with adjacent soils. It is fairly suited to corn and soybeans, and is moderately well suited to small grains. If cultivated crops are grown, further erosion is a severe hazard. Erosion can be adequately controlled for occasional row crops through a combination of conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, grassed waterways, contour farming, contour stripcropping, terraces, and a cropping rotation that includes grasses and legumes. Conservation practices upslope that increase the rate of water infiltration and reduce runoff will help to control erosion on this soil. Leaving crop residue on the surface or regularly adding other organic material to the soil helps to improve fertility and tilth, helps to prevent crusting, and increases the rate of water infiltration.

This soil is moderately well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. In some places terraces and diversions are needed to protect critically seeded areas.

This soil is well suited to trees, and a few areas remain in native hardwoods. New stands of trees are easily planted or harvested if species are properly selected and managed.

This soil is well suited to use as habitat for woodland wildlife. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas help to maintain or improve the habitat.

The land capability classification is IVe.

179E—Gara loam, 14 to 18 percent slopes. This moderately steep, moderately well drained soil is on convex nose slopes and valley side slopes on uplands. Areas are long and narrow or irregularly shaped, and commonly range from 5 to 50 or more acres in size.

Typically, the surface layer is very dark gray, friable loam about 8 inches thick. The subsurface layer is dark grayish brown, friable loam about 4 inches thick. The subsoil is about 38 inches thick. The upper part is dark yellowish brown, firm clay loam. The next part is yellowish brown, mottled, very firm clay. The lower part is yellowish brown and grayish brown, mottled, firm, calcareous clay loam, and has accumulations of lime. The substratum to a depth of about 60 inches is light brownish gray and yellowish brown, mottled, firm, calcareous clay loam, and has accumulations of lime. Stones and pebbles are in the subsoil and substratum. Scattered stones and boulders have come to the surface through the processes of freezing, thawing, and heaving. In some places the surface layer is mixed with streaks and pockets of dark yellowish brown clay loam subsoil material.

Included with this soil in mapping are small areas of the Armstrong and Bucknell soils on the less sloping shoulder slopes. These soils contain more clay in the subsoil, and typically are not as well drained as the Gara soil. They make up about 10 percent of the map unit.

Permeability of this Gara soil is moderately slow. Surface runoff is rapid. Available water capacity is high. The content of organic matter is about 2.5 to 3.5 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. This soil has good tilth, but tends to puddle if worked when wet. It crusts after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Most areas are used for hay and pasture, but some areas are cultivated. This soil generally is unsuited to corn, soybeans, and small grains because of the slope and the severe hazard of water erosion. It is moderately well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay helps to control water erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. In some places terraces and diversions are needed to protect critically seeded areas.

This soil is moderately well suited to trees, and some areas remain in native hardwoods. The hazard of water erosion and the equipment limitation are the main management concerns. Laying out the logging trails or roads on or nearly on the contour will help to control water erosion. Because of the slope, operating logging equipment is somewhat hazardous. Special logging equipment and caution in its use are needed. Other limitations or hazards that affect planting or harvesting trees are slight.

This soil is moderately well suited to use as habitat for woodland wildlife. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas help to maintain or improve the habitat.

The land capability classification is VIe.

179E2—Gara clay loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, moderately well drained soil is on convex nose slopes and valley side slopes on uplands. Areas are long and narrow or irregularly shaped, and commonly range from 5 to 50 or more acres in size.

Typically, the surface layer is very dark grayish brown, friable clay loam about 7 inches thick. It is mixed with streaks and pockets of dark yellowish brown subsoil material. The subsoil is about 38 inches thick. The upper part is dark yellowish brown, firm clay loam. The next part is yellowish brown, mottled, very firm clay. The lower part is yellowish brown and light brownish gray, mottled, firm, calcareous clay loam, and has accumulations of lime. The substratum to a depth of about 60 inches is light brownish gray and yellowish brown, mottled, firm, calcareous clay loam, and has accumulations of lime. Stones and pebbles are in the subsoil and substratum. Scattered stones and boulders have come to the surface through the processes of freezing, thawing, and heaving. In some places the surface layer is very dark gray loam about 8 inches thick and the subsurface layer is dark grayish brown loam about 4 inches thick. In some small severely eroded areas, the surface layer is mostly dark yellowish brown clay loam.

Included with this soil in mapping are small areas of the Armstrong and Bucknell soils on the less sloping shoulder slopes. These soils contain more clay in the subsoil, and typically are not as well drained as the Gara soil. They make up about 10 percent of the map unit.

Permeability of this Gara soil is moderately slow. Surface runoff is rapid. Available water capacity is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. This soil has fair tilth, and tends to puddle if worked when wet. It crusts after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Most areas are used for hay and pasture (fig. 11), but some areas are cultivated. This soil generally is unsuited to corn, soybeans, and small grains because of the slope and the severe hazard of further erosion. This soil is moderately well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. In some places terraces and diversions are needed to protect critically seeded areas.

This soil is moderately well suited to trees, and a few areas remain in native hardwoods. The hazard of erosion and the equipment limitations are the main management concerns. Laying out the logging trails or roads on or nearly on the contour will help to control erosion. Because of the slope, operating logging equipment is somewhat hazardous. Special logging equipment and caution in its use are needed. Other limitations or hazards that affect planting or harvesting trees are slight.

This soil is moderately well suited to use as habitat for woodland wildlife. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas help to maintain or improve the habitat.

The land capability classification is VIe.

Figure 11.—A pastured area of Gara clay loam, 14 to 18 percent slopes, moderately eroded, with a fenced farm pond. Farm ponds help prevent the formation of gullies and provide water for livestock.

179E3—Gara clay loam, 14 to 18 percent slopes, severely eroded. This moderately steep, moderately well drained soil is on convex nose slopes and valley side slopes on uplands. Areas are long and narrow or irregularly shaped, and commonly range from 3 to 15 acres or more in size.

Typically, the surface layer is brown, firm clay loam about 8 inches thick. It is mixed with 10 to 20 percent streaks and pockets of very dark grayish brown loam material of the original surface layer. The subsoil is about 38 inches thick. The upper part is yellowish brown, mottled, very firm clay. The next part is yellowish brown, mottled, firm clay loam. The lower part is yellowish brown and grayish brown, mottled, firm, calcareous clay loam, and has accumulations of lime. The substratum to a depth of about 60 inches is light brownish gray and yellowish brown, mottled, firm, calcareous clay loam, and has accumulations of lime. Stones and pebbles are in the subsoil and substratum. Scattered stones and boulders have come to the surface through the processes of freezing, thawing, and heaving. In some places the surface layer is mostly very dark grayish brown clay loam about 8 inches thick.

Included with this soil in mapping are small areas of the Armstrong and Bucknell soils on the less sloping shoulder slopes. These soils contain more clay in the subsoil, and typically are more poorly drained than the Gara soil. They make up 10 to 15 percent of the map unit.

Permeability of this Gara soil is moderately slow. Surface runoff is rapid. Available water capacity is high. The content of organic matter is about 1 to 2 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. This soil has poor tilth, and tends to puddle if worked when wet. It crusts after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Most areas are used for hay and pasture, but some areas are cultivated. Most areas have been cultivated in the past. This soil generally is unsuited to corn, soybeans, and small grains because of the slope and the severe hazard of further erosion. This soil is moderately well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay helps to control further erosion. A plant cover is somewhat difficult to establish on this severely eroded, moderately steep soil because of poor tilth. Overgrazing or grazing when the soil is too wet causes surface compaction, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in fair condition. In addition, suitable forage selection, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. In some places terraces and diversions are needed to protect critically seeded areas.

This soil is moderately well suited to trees. The hazard of erosion and the equipment limitation are the main management concerns. Laying out the logging trails or roads on or nearly on the contour will help to control erosion. Because of the slope, operating logging equipment is somewhat hazardous. Special equipment and caution in its use are needed. Other limitations or hazards that affect planting or harvesting trees are slight.

This soil is moderately well suited to use as habitat for woodland wildlife. Excluding livestock from tree-planted areas, constructing water impoundment reservoirs, planting shrubs, and establishing food plots adjacent to wooded areas help to improve the habitat.

The land capability classification is VIe.

179F—Gara loam, 18 to 25 percent slopes. This steep, moderately well drained soil is on convex valley side slopes on uplands. Areas are long and narrow or irregularly shaped, and commonly range from 5 to 50 acres or more in size.

Typically, the surface layer is very dark gray, friable loam about 7 inches thick. The subsurface layer is dark grayish brown and yellowish brown, friable loam about 3 inches thick. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is yellowish brown, friable clay loam. The next part is dark yellowish brown and yellowish brown, very firm clay. The lower part is yellowish brown, firm, calcareous clay loam, and has accumulations of lime. Stones and pebbles are in the subsoil. Scattered stones and boulders have come to the surface through the processes of freezing, thawing, and heaving. In some places, the surface layer is mixed with streaks and pockets of dark yellowish brown clay loam subsoil material. In other places the slopes are steeper.

Included with this soil in mapping are small areas of the Armstrong and Bucknell soils on the less sloping shoulder slopes. These soils contain more clay in the subsoil, and typically are more poorly drained than the Gara soil. They make up about 10 percent of the map unit.

Permeability of this Gara soil is moderately slow. Surface runoff is very rapid. Available water capacity is high. The content of organic matter is about 2.5 to 3.5 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. This soil has good tilth, but tends to puddle if worked when wet and to crust after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Most areas are used for pasture, hay, and woodland. A few areas are cultivated. This soil generally is unsuited to cultivated crops because of the slope and the severe hazard of water erosion. It is moderately well suited to pasture, hay, and trees. Establishing a plant cover on the areas that have been cleared for pasture and hay is somewhat difficult because of the slope and the severe hazard of erosion. The slope and the gullies and waterways limit the use of farm machinery.

This soil is best suited to grasses and legumes for hay and pasture. A permanent plant cover is effective in controlling water erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. Erosion is a severe problem because of steepness of slope; consequently, when pasture and hayland are renovated, the use of special equipment and cultural measures applied on the contour are needed. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

This soil is moderately well suited to trees, and many areas remain in native hardwoods. The hazard of erosion and the equipment limitation are the main management concerns. Laying out logging trails or roads on or nearly on the contour will help to control erosion. Because of the slope, operating logging equipment is dangerous. Special logging equipment and caution in its use are needed. Other limitations or hazards that affect planting or harvesting trees are slight.

This soil is moderately well suited to use as habitat for woodland wildlife. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas help to maintain or improve the habitat.

The land capability classification is VIe.

179F2—Gara clay loam, 18 to 25 percent slopes, moderately eroded. This steep, moderately well drained soil is on convex valley side slopes on uplands. Areas are long and narrow or irregularly shaped, and commonly range from 5 to 50 acres or more in size.

Typically, the surface layer is very dark grayish brown, friable clay loam about 7 inches thick. It is mixed with streaks and pockets of dark yellowish brown subsoil material. The subsoil is about 45 inches thick. The upper part is dark yellowish brown, firm clay loam. The next part is yellowish brown, very firm clay. The lower part is yellowish brown and light brownish gray, firm, calcareous clay loam, and has accumulations of lime. The substratum to a depth of about 60 inches is yellowish brown and light brownish gray, mottled, firm, calcareous clay loam, and has accumulations of lime. Stones and pebbles are in the subsoil and substratum. Scattered stones and boulders have come to the surface through the processes of freezing, thawing, and heaving. In some places the surface layer is very dark gray loam about 7 inches thick and the subsurface layer is dark grayish brown loam about 3 inches thick. In some small severely eroded areas, the surface layer is mostly dark yellowish brown clay loam. In places the slope is steeper than 25 percent.

Included with this soil in mapping are small areas of the Armstrong and Bucknell soils on the less sloping shoulder slopes. These soils contain more clay in the subsoil, and typically are more poorly drained than the Gara soil. They make up about 10 percent of the map unit.

Permeability of this Gara soil is moderately slow. Surface runoff is very rapid. Available water capacity is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. This soil has fair tilth, and tends to puddle if worked when wet and to crust after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Many areas are used for hay and pasture. Some areas are cultivated. This soil generally is unsuited to cultivated crops because of the slope and the severe hazard of further erosion. It is moderately well suited to pasture, hay, and trees. Establishing a plant cover on the areas that have been cleared for pasture and hay is difficult because of the slope and the severe hazard of further erosion. The slope and the gullies and waterways limit the use of farm machinery.

This soil is best suited to grasses and legumes for hay and pasture. A permanent plant cover is effective in controlling further soil erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. Erosion is a severe problem because of steepness of slope; consequently, the use of special equipment and cultural measures applied on the contour are needed when pasture and hayland are renovated. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

This soil is moderately well suited to trees, and few areas remain in native hardwoods. The hazard of erosion and the equipment limitation are the main management concerns. Laying out logging trails or roads on or nearly on the contour will help to control erosion. Because of the slope, operating logging equipment is dangerous. Special logging equipment and caution in its use are needed. Seedlings survive and grow well. Other limitations or hazards that affect planting or harvesting trees are slight.

This soil is moderately well suited to use as habitat for woodland wildlife. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas help to maintain or improve the habitat.

The land capability classification is VIIe.

192C—Adair loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained and somewhat poorly drained soil is on convex ridgetops and shoulder slopes on uplands. Areas are long and narrow or irregularly shaped, and commonly range from 4 to 20 acres in size.

Typically, the surface layer is black, friable loam about 8 inches thick. The subsurface layer is very dark grayish brown, friable clay loam about 3 inches thick. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is brown, firm clay loam. The next part is reddish brown, red, and strong brown, very firm clay. The lower part is yellowish brown and light brownish gray, very firm and firm clay and clay loam. In some places the surface layer is mixed with streaks and pockets of brown clay loam subsoil material.

Permeability of this Adair soil is slow. Surface runoff is medium. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has good tilth, but tends to puddle if worked when wet.

Many areas are used for hay and pasture. Some areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grains. It is well suited to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a severe hazard. Water erosion can be adequately controlled in intensively row-cropped areas through a combination of conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed waterways, grassed headlands, a cropping rotation that includes grasses and legumes, and terraces. If terraces are built, cuts should be held to a minimum depth to avoid exposure of the clayey subsoil, or topsoil should be stockpiled and spread over excavated and built-up areas to ease restoration of productivity. This soil is wet and seepy during wet periods. Seepy and wet spots are common near the contact with the loess-covered soils upslope. The installation of interceptor tiles above the seep line lowers the seasonal high water table, and benefits row crops and grasses and legumes for hay and pasture. Regular additions of organic material to the soil improve soil fertility, maintain good tilth, and increase the rate of water infiltration.

This soil is best suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay is also effective in controlling water erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

The land capability classification is IIIe.

192C2—Adair clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained and somewhat poorly drained soil is on convex ridgetops and shoulder slopes on uplands. Areas are long and narrow or irregularly shaped, and commonly range from 5 to 30 acres or more in size.

Typically, the surface layer is very dark gray, friable clay loam about 8 inches thick. It is mixed with streaks and pockets of brown subsoil material. The subsoil extends to a depth of about 60 inches. It is mottled. The upper part is brown, firm clay loam. The next part is strong brown, very firm clay. The lower part is reddish brown, strong brown, yellowish brown, and light brownish gray, very firm and firm clay and clay loam. In some places the surface layer and subsurface layer are black, very dark gray, and very dark grayish brown, and are 10 or more inches thick. In small severely eroded areas, the surface layer is mostly brown clay loam.

Permeability of this Adair soil is slow. Surface runoff is medium. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has good tilth, but tends to puddle if worked when wet.

Many areas are used for cultivated crops. Some areas are used for hay and pasture. This soil is moderately well suited to corn, soybeans, and small grains. It is well suited to grasses and legumes for hay and pasture.

If cultivated crops are grown, further erosion is a severe hazard. Erosion can be adequately controlled in intensively row-cropped areas through a combination of conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed waterways, grassed headlands, a cropping rotation that includes grasses and legumes, and terraces. If terraces are built, cuts should be held to a minimum depth to avoid exposure of the clayey subsoil or the topsoil should be stockpiled and spread over excavated and built-up areas to ease restoration of productivity.

This soil is wet and seepy during wet periods. Seepy and wet spots are common near the contact with the loess-covered soils upslope. The installation of interceptor tiles above the seep line lowers the seasonal high water table, and is beneficial to row crops and to grasses and legumes for hay and pasture. Regular additions of organic material to the soil improve soil fertility and tilth, and increase the rate of water infiltration. This soil generally needs more nitrogen than the uneroded Adair soils, and requires greater production inputs to maintain higher yields and to maintain or improve tilth.

This soil is best suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay is also effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard, and results in a minimum loss of grazing or hay production during the seeding year.

The land capability classification is IIIe.

192D—Adair loam, 9 to 14 percent slopes. This strongly sloping, moderately well drained and somewhat poorly drained soil is on convex ridgetops, nose slopes, and shoulder slopes on uplands. Areas are long and narrow or irregularly shaped, and commonly range from 4 to 20 acres or more in size.

Typically, the surface layer is black, friable loam about 8 inches thick. The subsurface layer is very dark gray, friable clay loam about 3 inches thick. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is very dark grayish brown and brown, firm clay loam. The next part is yellowish red, very firm clay. The lower part is yellowish brown and strong brown, very firm and firm clay and clay loam. In some places the surface layer is mixed with streaks and pockets of brown clay loam subsoil material. Also, in places the subsoil does not have reddish hues and contains less clay.

Permeability of this Adair soil is slow. Surface runoff is rapid. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has good tilth, but tends to puddle if worked when wet.

Most areas are used for hay and pasture. Some areas are cultivated. This soil is moderately well suited to occasional row crops. It is well suited to small grains and to grasses and legumes for hay and pasture. If row crops are grown, erosion is a severe hazard. Erosion can be adequately controlled for occasional row crops through a combination of conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour stripcropping, grassed waterways, grassed headlands, a cropping rotation that includes grasses and legumes, and terraces. This soil is wet and seepy during wet periods. Seepy and wet spots are common near the contact with loess-covered soils upslope. The installation of interceptor tiles above the seep line lowers the seasonal high water table, and benefits row crops and grasses and legumes for hay and pasture. Regular additions of organic material to the soil help to improve fertility, maintain good tilth, and also increase the rate of water infiltration.

This soil is best suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay is also effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

The land capability classification is IVe.

192D2—Adair clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained and somewhat poorly drained soil is on convex ridgetops, nose slopes, and shoulder slopes on uplands. Areas are long and narrow or irregularly shaped, and commonly range from 5 to 40 acres or more in size.

Typically, the surface layer is very dark gray, friable clay loam about 8 inches thick. It is mixed with streaks and pockets of brown subsoil material. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is brown and strong brown, very firm clay. The next part is yellowish red and gray, very firm clay. The lower part is yellowish brown and light brownish gray, firm clay loam.

Permeability of this Adair soil is slow. Surface runoff is rapid. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has good tilth, but tends to puddle if worked when wet and to crust after hard rains.

Most areas are cultivated. Some areas are used for hay and pasture. In most areas this soil is managed along with the adjacent soils. This soil is poorly suited to row crops. It is moderately well suited to small grains and to grasses and legumes for hay and pasture. If row crops are grown, further soil erosion is a severe hazard. Erosion can be adequately controlled for occasional row crops through a combination of conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed waterways, grassed headlands, a cropping rotation that includes grasses and legumes, and terraces. This soil is wet and seepy during wet periods. Seepy and wet spots are common near the contact with loess-covered soils upslope. The installation of interceptor tiles above the seep line lowers the seasonal high water table, and benefits row crops as well as grasses and legumes for hay and pasture. Regular additions of organic material to the soil help to improve fertility, maintain good tilth, help to prevent crusting, and increase the rate of water infiltration. This soil generally needs more nitrogen than the uneroded Adair soils, and greater production inputs are needed to maintain higher yields and to maintain or improve tilth.

This soil is best suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay is also effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard, and results in a minimum loss of grazing or hay production during the seeding year.

The land capability classification is IVe.

192D3—Adair clay loam, 9 to 14 percent slopes, severely eroded. This strongly sloping, moderately well drained and somewhat poorly drained soil is on convex ridgetops, nose slopes, and shoulder slopes on uplands. Areas are long and narrow or irregularly shaped, and commonly range from 3 to 15 acres or more in size.

Typically, the surface layer is brown, firm clay loam about 7 inches thick. It is mixed with 20 to 25 percent streaks and pockets of very dark gray loam material of the original surface layer. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is red, brown, and yellowish red, very firm clay. The next part is strong brown and gray, very firm clay. The lower part is yellowish brown and light brownish gray, firm clay loam. Stones and pebbles are scattered on the surface as well as in the subsoil and substratum. In some places the surface layer is very dark gray, friable clay loam about 8 inches thick. It is mixed with streaks and pockets of brown clay loam subsoil material because of erosion and plowing.

Permeability of this Adair soil is slow. Surface runoff is rapid. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 1 to 2 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has poor tilth, and tends to puddle if worked when wet and to crust after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Many areas are cultivated. Some areas are used for hay and pasture. In most areas these soils are managed along with the adjacent soils. Because of the slope and the severe hazard of further erosion, this soil generally is unsuited to corn, soybeans, and small grains. It is suited to grasses and legumes for hay and pasture. A permanent cover of pasture plants or hay is effective in controlling further erosion. However, managing pasture and hayland may be difficult because this soil is wet and seepy during wet periods, and has poor tilth. The installation of interceptor tiles on adjacent soils above the seep line benefits grasses and legumes for hay and pasture production. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in fair condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the hazard of further erosion and results in a minimum loss of grazing or hay production during the seeding year.

The land capability classification is VIe.

211—Edina silt loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on narrow to broad, interstream divides on loess-covered uplands. Areas are irregularly shaped, and commonly range from 3 to 25 acres or more in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 10 inches thick. The subsurface layer is grayish brown and dark grayish brown, friable silt loam and silty clay loam about 8 inches thick. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is very dark gray and dark gray, very firm silty clay. The next part is dark grayish brown and grayish brown, very firm silty clay. The lower part is grayish brown, firm silty clay loam.

Included with this soil in mapping are small areas of the Haig soils. These soils are in the convex areas between shallow depressions, and can be drained more easily than the Edina soil. They make up 5 to 10 percent of the map unit.

Permeability of this Edina soil is very slow. Surface runoff is very slow. Available water capacity is moderate. The soil has a seasonal high water table at a depth of 0.5 to 2.0 feet. The shrink-swell potential is very high. The content of organic matter is about 3.5 to 4.5 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has fair tilth, and tends to puddle if worked when wet.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. Adequate subsurface drainage is very difficult because of the high content of clay in the subsoil. A surface drainage or tile intake system helps to reduce ponding and thus helps to prevent the drowning of crops. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and the low soil temperature in spring. However, this system needs to be arranged so water will run off this soil.

This soil is suited to grasses and legumes for hay and pasture. However, management may be difficult because this soil is poorly drained and is ponded for brief periods. Forage species that tolerate wetness will help to maintain productivity. Surface drainage is necessary for alfalfa crops. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases ponding. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture and the soil in good condition. In addition, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland.

The land capability classification is IIIw.

220—Nodaway silt loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is in areas of recent deposition on bottom land near major streams. It is subject to flooding. Areas are long and narrow or irregularly shaped, and commonly range from 10 to 60 acres or more in size.

Typically, the surface layer is very dark gray and very dark grayish brown, friable silt loam about 9 inches thick. The substratum to a depth of about 60 inches is stratified dark grayish brown, very dark grayish brown, grayish brown, and very dark gray, mottled, friable silt loam and thin layers of fine sandy loam, loam, sandy loam, or silty clay loam. In some places, the surface layer is loam, silty clay loam, or sandy loam.

Included with this soil in mapping are small scattered areas of the poorly drained Colo soils and the somewhat poorly drained Lawson soils. They are in landscape positions similar to those of the Nodaway soil. These soils make up 10 to 15 percent of the map unit.

Permeability of this Nodaway soil is moderate. Surface runoff is slow. Available water capacity is very high. The soil has a seasonal high water table at a depth of 3 to 5 feet. The content of organic matter is about 1.5 to 2.5 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. This soil has good tilth.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. In many years row crops can be grown if the soil is adequately protected from floodwater. In many areas diversion terraces are needed to protect the soil from the runoff from the higher surrounding areas. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and the low soil temperature.

This soil is suited to grasses and legumes for hay and pasture. Most areas that are narrow or are dissected by old streams are in permanent pasture. However, overgrazing or grazing during wet periods after flooding causes surface compaction and puddling of the soil. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland.

This soil is well suited to trees, and a few small areas remain in native hardwoods. New stands of trees are easily harvested or planted if species are properly selected and managed.

The land capability classification is IIw.

222C—Clarinda silty clay loam, 5 to 9 percent slopes. This moderately sloping, poorly drained soil is on short, convex side slopes and in coves at the heads of drainageways on uplands. Areas are long and narrow or irregularly shaped, and commonly range from 5 to 30 acres or more in size.

Typically, the surface layer is black, friable silty clay loam about 9 inches thick. The subsurface layer is very dark gray, very firm silty clay about 3 inches thick. The subsoil extends to a depth of about 60 inches. It is mottled. The upper part is dark gray, very firm silty clay, and the lower part is gray, very firm clay. In some places the surface layer is mixed with streaks and pockets of dark gray silty clay subsoil material.

Included with this soil in mapping are small areas of Arispe and Clearfield soils. The Arispe and Clearfield soils are upslope, and have less clay content in the subsoil than the Clarinda soil. These soils make up 10 to 15 percent of the map unit.

The Clarinda soil is very slowly permeable. Surface runoff is medium. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has fair tilth, and tends to puddle and to clod if worked when wet.

Most areas are used for cultivated crops, hay, and pasture. Areas of this soil generally are in narrow bands below the loess soils and are farmed along with adjacent soils. The soil is poorly suited to intensive row cropping. It is moderately well suited to small grains and to grasses and legumes for hay and pasture. If cultivated crops are grown, the wetness is a very serious limitation and erosion is a severe hazard. Subsurface drainage is not feasible in this very slowly permeable soil. Installation of interceptor tiles in the more permeable soils upslope lowers the seasonal high water table in this soil. Erosion can be adequately controlled for occasional row crops through a combination of conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, and a cropping rotation that includes grasses and legumes. Grassed waterways help to prevent gully erosion. Leaving residue on the surface and regularly adding organic material to the soil help to improve fertility and tilth and to increase the rate of water infiltration.

This soil is best suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay is also effective in controlling erosion. Management of pasture and hayland can be difficult because this soil is wet and seepy in spring and early summer. Forage species that tolerate wetness will help to maintain productivity. The installation of interceptor tiles on adjacent upslope soils helps to reduce wetness and seepy spots. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

The land capability classification is IVw.

222C2—Clarinda silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, poorly drained soil is on short, convex side slopes and in coves at the heads of drainageways on uplands. Areas are long and narrow or irregularly shaped, and commonly range from 8 to 50 acres or more in size.

Typically, the surface layer is black, friable silty clay loam about 9 inches thick. It is mixed with streaks and pockets of dark gray silty clay subsoil material. The subsoil extends to a depth of about 60 inches. It is mottled and very firm. The upper part is dark gray silty clay, and the lower part is gray and light gray clay. In some places the surface layer and subsurface layer are black and very dark gray, friable silty clay loam 10 inches or more thick.

Included with this soil in mapping are small areas of the Arispe and Clearfield soils. The Arispe and Clearfield soils are upslope, and have less clay content in the subsoil than the Clarinda soil. Also included are small areas scattered throughout the map unit where the surface layer is dark gray, very firm silty clay. These areas make up 10 to 15 percent of the map unit.

Permeability of this Clarinda soil is very slow. Surface runoff is medium. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has fair tilth, and tends to puddle and to clod if worked when wet.

Most areas are cultivated. Areas of this soil generally are in narrow bands below the loess soils, and are farmed along with adjacent soils. This soil is poorly suited to intensive row cropping. It is moderately well suited to small grains and to grasses and legumes for hay and pasture. If cultivated crops are grown, wetness is a very serious limitation and further erosion is a severe hazard. Subsurface drainage is not feasible because this soil is very slowly permeable. Installing interceptor tiles in the more permeable soils upslope helps to reduce wetness in this soil. Erosion can be adequately controlled for occasional row crops through a combination of soil conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, and a cropping rotation that includes grasses and legumes. Grassed waterways help to prevent gully erosion. Leaving residue on the surface and regularly adding organic material to the soil help to improve fertility and tilth and increase the rate of water infiltration.

This soil is best suited to grasses and legumes for hay and pasture (fig. 12). A cover of pasture plants or hay is also effective in controlling soil erosion. Management of pasture and hayland can be difficult because this soil is wet and seepy in spring and early summer. Forage species that tolerate wetness will help to maintain productivity. Installing interceptor tiles on adjacent upslope soils helps to reduce wetness and seepy spots. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding

Figure 12.—An area of hayland on Clarinda silty clay loam, 5 to 9 percent slopes, moderately eroded. Crop rotations help to control erosion on this soil.

grasses and legumes into the existing sod minimizes the erosion hazard, and results in a minimum loss of grazing or hay production during the seeding year.

The land capability classification is IVw.

222C3—Clarinda silty clay, 5 to 9 percent slopes, severely eroded. This moderately sloping, poorly drained soil is on short, convex side slopes and in coves at the heads of drainageways on uplands. Areas are long and narrow or irregular in shape, and commonly range from 5 to 25 acres or more in size.

Typically, the surface layer is dark grayish brown and very dark gray, very firm silty clay about 4 inches thick. It is mixed with 20 to 25 percent streaks and pockets of black material from the original surface layer. The subsoil extends to a depth of about 60 inches. It is mottled and very firm. The upper part is dark grayish brown and dark gray silty clay, and the lower part is gray and light gray clay. In some places the surface layer is black or very dark gray silty clay loam 7 to 9 inches thick. It is mixed with streaks and pockets of dark grayish brown or dark gray silty clay subsoil material.

Included with this soil in mapping are small areas of Arispe and Clearfield soils. These soils are upslope, and have less clay content in the subsoil than the Clarinda soil. These soils make up 10 to 15 percent of the map unit.

Permeability of this Clarinda soil is very slow. Surface runoff is medium. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 1.5 to 2.5 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has poor tilth, and tends to puddle and to clod if worked when wet.

Most areas are cultivated, or have been cultivated in the past. Some areas are used for hay and pasture. This soil generally is farmed along with the adjoining soils. It generally is unsuited to corn, soybeans, and small grains. It is poorly suited to grasses and legumes for hay and pasture. If cultivated crops are grown, the seasonal high water table is a very serious limitation and further erosion is a severe hazard. Surface crusting also adversely affects seedling emergence. The surface layer tends to seal and to crust after hard rains. As a result, the rate of water infiltration is reduced and the runoff rate is increased. The increased runoff rate accelerates sheet and gully erosion.

This soil is suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay is also effective in controlling soil erosion. Management of pasture and hayland may be difficult because this soil is wet and seepy in spring and early summer. Forage species that tolerate wetness will help to maintain productivity. Installing interceptor tiles on adjacent, upslope soils helps to reduce wetness and seepy spots. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

The land capability classification is VIe.

222D2—Clarinda silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, poorly drained soil is on short, convex side slopes and in coves at the heads of drainageways on uplands. Areas are long and narrow or irregular in shape, and commonly range from 8 to 30 or more acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 7 inches thick. It is mixed with streaks and pockets of dark gray and dark grayish brown silty clay subsoil material. The subsoil extends to a depth of about 60 inches. It is mottled and very firm. The upper part is dark gray silty clay, and the lower part is gray and light gray clay. In some places the surface and subsurface layers are black and very dark gray, friable silty clay loam about 10 or more inches thick.

Included with this soil in mapping are small areas of Arispe and Clearfield soils on the less sloping, upper part of the slopes. These soils have less clay content in the subsoil than the Clarinda soil. Also included are small areas scattered throughout the map unit where the surface layer is dark gray, very firm silty clay. These areas have poor tilth, and are very difficult to prepare as a seedbed. Included areas make up about 10 percent of the map unit.

Permeability of this Clarinda soil is very slow. Surface runoff is rapid. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has fair tilth, and tends to puddle and to clod if worked when wet and to crust after hard rains.

Most areas are used for cultivated crops, hay, or pasture. Areas of this soil generally are in narrow bands below the loess soils, and are farmed along with adjacent soils. This soil is poorly suited to corn and soybeans. It is moderately well suited to small grains and to grasses and legumes for hay and pasture. If cultivated crops are grown, wetness is a very serious limitation and further erosion is a severe hazard. Erosion can be adequately controlled for occasional row crops through a combination of conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, and a cropping rotation that includes grasses and legumes. Grassed waterways help to prevent gully erosion. Subsurface drainage is not feasible on this very slowly permeable soil. Installing interceptor tiles in the more permeable soils upslope helps to reduce wetness on this soil. Leaving residue on the surface and regularly adding organic material to the soil help to improve fertility and tilth, to prevent crusting, and to increase the rate of water infiltration.

This soil is suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay is also effective in controlling erosion. Management of pasture and hayland may be difficult because this soil is wet and seepy in spring and early summer. Forage species that tolerate wetness will help to maintain productivity. Installing interceptor tiles on the adjacent, upslope soils helps to reduce wetness and seepy spots. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation and interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

The land capability classification is IVe.

269—Humeston silt loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on flat, concave foot slopes and slightly concave slack water areas on bottom land. It is subject to flooding. Areas are irregular in shape, and commonly range from 4 to 20 or more acres in size.

Typically, the surface layer is very dark gray and black, friable silt loam about 9 inches thick. The next layer is black, friable silt loam about 7 inches thick. The subsurface layer is dark gray and gray, friable silt loam about 12 inches thick. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is very dark gray, friable silty clay loam. The next part is black and very dark gray, firm silty clay. The lower part is dark gray and very dark gray, firm silty clay loam.

Permeability of this Humeston soil is very slow. Surface runoff is very slow. Available water capacity is high. The soil has a seasonal high water table between the surface and a depth of 1 foot. The shrink-swell potential is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. This soil has fair tilth, and tends to puddle if worked when wet.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grains. It is well suited to grasses and legumes for hay and pasture. Row crops can be grown much of the time if the soil is adequately drained and protected from floodwater. Tile drains generally do not work satisfactorily in this very slowly permeable soil. In the lower areas flooding also limits their use. Open ditches, surface drainage, and diversions all help to remove surface water and to reduce wetness. This soil warms slowly in the spring and dries slowly after rains. In years of heavy rainfall, planting is delayed. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to reduce wetness and to overcome the low soil temperature. Adding organic material and deferring tillage when the soil is wet help to maintain good tilth, to improve fertility, to prevent crusting, and to increase the rate of water infiltration.

This soil is suited to grasses and legumes for hay and pasture. However, overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases ponding. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland.

This soil is in capability subclass IIIw.

273B—Olmitz loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on alluvial fans and slightly concave to plane foot slopes on bottom land. It is downslope from moderately steep or steep soils that formed in glacial till. Areas are long and narrow, and commonly range from 5 to 25 acres or more in size.

Typically, the surface layer is very dark brown, friable loam about 9 inches thick. The subsurface layer is about 22 inches thick. The upper part is very dark brown, friable clay loam, and the lower part is very dark grayish brown, friable clay loam. The subsoil extends to a depth of about 60 inches, and is friable clay loam. The upper part is brown, and the lower part is dark yellowish brown and has strong brown mottles. In some places the subsoil has a higher clay content and is somewhat poorly drained.

Included with this soil in mapping are small areas of the Zook soils on the lower part of slopes. The Zook soils have a higher clay content, and are poorly drained. These areas make up about 10 percent of the map unit.

Permeability of this Olmitz soil is moderate. Surface runoff is slow. Available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The lower part of the subsurface layer and the subsoil generally have a very low supply of available phosphorus and a low supply of available potassium. This soil has good tilth.

Many areas are used for cultivated crops. Some areas are used for hay and pasture. This soil is well suited to corn, soybeans, and small grains. It can be used for intensive row crops. The main management concerns are flooding of brief duration and accumulation of less fertile, loamy sediments from the upslope soils. Also, erosion is a slight or moderate hazard. Constructing diversions on foot slopes above this soil can help to reduce flooding. A system of conservation tillage that leaves crop residue on the surface helps to control erosion. Grassed waterways help to prevent gully erosion. Regular additions of organic material to the soil improve fertility and maintain good tilth.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation, if done on the contour, helps to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. In some places terraces and diversions are needed to protect critically seeded areas.

The land capability classification is IIe.

273C—Olmitz loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on alluvial fans and slightly concave to plane foot slopes on bottom land. It is downslope from moderately steep to steep soils that formed in glacial till. Areas are long and narrow, and commonly range from 5 to 30 acres or more in size.

Typically, the surface layer is very dark brown, friable loam about 9 inches thick. The subsurface layer is friable clay loam about 22 inches thick. The upper part is very dark brown, and the lower part is very dark grayish brown. The subsoil extends to a depth of about 60 inches. It is brown, friable clay loam in the upper part and dark yellowish brown, friable clay loam in the lower part. Some small places are gently sloping.

Permeability of this Olmitz soil is moderate. Surface runoff is medium. Available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The lower part of the subsurface layer and the subsoil generally have a very low supply of available phosphorus and a low supply of available potassium. This soil has good tilth.

Many areas are cultivated. Some areas are used for hay and pasture. This soil is moderately well suited to corn, soybeans, and small grains. If cultivated crops are grown intensively, erosion is a hazard. Also, the soil receives runoff from the adjoining upslope soils. Erosion can be adequately controlled in intensively row-cropped areas through a combination of conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, grassed waterways, contour farming, terraces, and a cropping rotation that includes grasses and legumes. Constructing diversions on foot slopes above this soil helps to reduce runoff from the adjoining higher slopes. Regularly adding organic material to the soil improves fertility and helps to maintain good tilth.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation, if done on the contour, helps to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. In some places terraces and diversions are needed to protect critically seeded areas.

The land capability classification is IIIe.

362—Haig silt loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is in the broad upland divides. Areas are irregular in shape, and commonly range from 5 to 100 acres or more in size.

Typically, the surface layer is black, friable silt loam about 7 inches thick. The subsurface layer is black, friable silty clay loam about 8 inches thick. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is very dark gray and dark gray, firm and very firm silty clay loam and very firm silty clay; the next part is olive gray, firm silty clay; and the lower part is light olive gray, firm and friable silty clay loam. In some places the surface layer is black silty clay loam.

Included with this soil in mapping are small areas of the Edina soils. The Edina soils are in shallow depressions. Draining these soils is more difficult than draining the Haig soil. These areas make up 5 to 10 percent of the map unit.

Permeability of this Haig soil is slow. Surface runoff is very slow. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 2 feet. The shrink-swell potential is high. The content of organic matter is about 3.5 to 4.5 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium. This soil has fair tilth, and tends to puddle if worked when wet.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grains. If the soil is adequately drained, row crops can be grown in many years. Tile drains generally do not function very satisfactorily in wide areas of this slowly permeable soil where suitable outlets are not available. A surface drainage system will help to remove surface water. Because the soil warms slowly in spring and dries slowly after rainfall, fieldwork is often delayed. If rainfall is heavy, planting is delayed. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to reduce wetness and to overcome the low soil temperature. Fall plowing improves the timeliness of fieldwork, but increases the susceptibility to wind erosion. Fall primary tillage that leaves about 50 percent crop residue on the surface reduces wind erosion and improves the timeliness of spring fieldwork. Regular additions of organic material to the soil improve fertility and tilth.

This soil is well suited to grasses and legumes for hay and pasture. However, overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases ponding. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland.

The land capability classification is IIw.

364B—Grundy silty clay loam, 2 to 5 percent slopes. This gently sloping, somewhat poorly drained soil is on the convex ridgetops and convex side slopes on uplands. Areas are long and narrow or irregular in shape, and commonly range from 8 to 120 acres or more in size.

Typically, the surface layer is black, friable silty clay loam about 9 inches thick. The subsurface layer is black and very dark gray, friable silty clay loam about 6 inches thick. The subsoil is about 38 inches thick, and is mottled. The upper part is dark grayish brown and grayish brown, firm silty clay; the next part is grayish brown, firm silty clay loam; and the lower part is olive gray, friable silty clay loam. The substratum to a depth of about 60 inches is light olive gray, mottled, friable silty clay loam.

Included with this soil in mapping are small areas of the poorly drained Haig soils on the less sloping part of the landscape. These areas make up about 5 to 10 percent of the map unit.

Permeability of this Grundy soil is slow. Surface runoff is medium. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium. This soil has good tilth, but tends to puddle if worked when wet.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grains. If cultivated crops are grown, water erosion is a moderate hazard. In most years row crops can be grown if erosion is controlled. Water erosion can be adequately controlled in intensively row-cropped areas through a combination of conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, grassed headlands, contour farming, contour stripcropping, a cropping rotation that includes grasses and legumes, and terraces. If terraces are built, cuts should be held to a minimum depth to avoid exposure of the clayey subsoil, or topsoil should be stockpiled and spread over the excavated and built-up areas to ease the restoration of productivity. Since exposing the subsoil may result in seepy terrace channels, a combination of tile drainage and terraces works well. Grassed waterways help to prevent gully erosion. This slowly permeable soil tends to warm more slowly in spring than the more permeable soils, and it dries more slowly after rains. Regular additions of organic material to the soil improve fertility, maintain good tilth, and increase the rate of water infiltration.

This soil is well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay is also effective in controlling water erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

The land capability classification is IIe.

368—Macksburg silty clay loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is in the moderately broad, upland divides. Areas are irregular in shape, and commonly range from 5 to 40 acres or more in size.

Typically, the surface layer is black, friable silty clay loam about 10 inches thick. The subsurface layer is black and very dark grayish brown, friable silty clay loam about 9 inches thick. The subsoil is about 35 inches thick. The upper part is brown and dark grayish brown, mottled, firm silty clay loam; the next part is grayish brown, mottled, firm silty clay and silty clay loam; and the lower part is light brownish gray, mottled, friable silty clay loam. The substratum to a depth of about 60 inches is light brownish gray, mottled, friable silty clay loam.

Included with this soil in mapping are small areas of the poorly drained Winterset soils on small flats on uplands. These soils make up 5 to 10 percent of the map unit.

Permeability of this Macksburg soil is moderately slow. Surface runoff is slow. Available water capacity is high. The soil has a seasonal high water table at a depth of 2 to 4 feet. The shrink-swell potential is high. The content of organic matter is about 4.5 to 5.5 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium. This soil has good tilth, but tends to puddle if worked when wet.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grains. Row crops can be grown in most years. Most areas are adequately drained. In some areas tile drains are needed to improve the timeliness of fieldwork in wet years. Regularly adding organic material to the soil improves fertility, maintains good tilth, and increases the rate of water infiltration.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and impairs tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland.

The land capability classification is I.

368B—Macksburg silty clay loam, 2 to 5 percent slopes. This gently sloping, somewhat poorly drained soil is on convex ridgetops and convex side slopes on uplands. Areas are irregular in shape or long and narrow, and commonly range from 5 to 150 acres or more in size.

Typically, the surface layer is black, friable silty clay loam about 9 inches thick. The subsurface layer is black and very dark grayish brown, friable silty clay loam about 9 inches thick. The subsoil is about 35 inches thick. The upper part is brown and dark grayish brown, mottled, firm silty clay loam; the next part is grayish brown, mottled, firm silty clay and silty clay loam; and the lower part is light brownish gray, mottled, friable silty clay loam. The substratum to a depth of about 60 inches is light olive gray, mottled, friable silty clay loam. Some small areas are nearly level.

Permeability of this Macksburg soil is moderately slow. Surface runoff is medium. Available water capacity is high. The soil has a seasonal high water table at a depth of 2 to 4 feet. The shrink-swell potential is high. The content of organic matter is about 4.5 to 5.5 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium. This soil has good tilth, but tends to puddle if worked when wet.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grains. If cultivated crops are grown, water erosion is a moderate hazard. In most years row crops can be grown if erosion is controlled. Water erosion can be adequately controlled in intensively row-cropped areas through a combination of conservation practices (fig. 13). These practices can be a system of conservation tillage that leaves crop

Figure 13.—Planting no-till soybeans helps to control water erosion on Macksburg silty clay loam, 2 to 5 percent slopes.

residue on the surface, winter cover crops, grassed headlands, contour farming, contour stripcropping, a cropping rotation that includes grasses and legumes, and terraces. If terraces are built, a combination of terraces and tile drainage works well to improve the timeliness of fieldwork in wet years and to control erosion. If necessary, topsoil should be stockpiled and spread over the excavated and built-up areas to ease restoration of productivity. Grassed waterways help to prevent gully erosion. Regular additions of organic material to the soil improve fertility, maintain good tilth, and increase the rate of water infiltration.

This soil is well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

The land capability classification is IIe.

369—Winterset silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on broad upland flats. Areas are irregular in shape and have rounded boundaries, and commonly range from 5 to 20 acres or more in size.

Typically, the surface layer is black, friable silty clay loam about 8 inches thick. The subsurface layer is black, friable silty clay loam about 11 inches thick, and is mottled in the lower part. The subsoil is about 31 inches thick, and is mottled. The upper part is very dark gray, dark grayish brown, and grayish brown, firm silty clay; the next part is grayish brown, firm silty clay loam; and the lower part is olive gray, friable silty clay loam. The substratum to a depth of about 60 inches is light olive gray, mottled, friable silty clay loam.

Included with this soil in mapping are small areas of planosolic soils in shallow depressions. These areas are ponded after rains and are shown on the maps by a special symbol. Also included are small areas of somewhat poorly drained Macksburg soils on the convex, sloping part of the landscape. Included areas make up about 10 percent of the map unit.

Permeability of this Winterset soil is moderately slow. Surface runoff is slow. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 2 feet. The shrink-swell potential is high. The content of organic matter is about 5 to 6 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium. This soil has fair tilth, and tends to puddle if worked when wet.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grains. Row crops can be grown in many years. The main management concern is wetness caused by poor drainage. Tile drains function satisfactorily in this soil and help to reduce wetness, to improve aeration, and to provide a deep root zone for plants. This poorly drained soil tends to warm more slowly in spring than the more permeable, better drained soils, and it dries more slowly after rains. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to reduce wetness and to overcome the low soil temperature. Fall primary tillage that leaves about 50 percent of crop residue on the surface helps to control wind erosion and allows timelier fieldwork in spring. Regular additions of organic material to the soil improve fertility and tilth and increase the rate of water infiltration.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and results in poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland.

The land capability classification is IIw.

370B—Sharpsburg silty clay loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on convex ridgetops and short, convex side slopes on uplands. Areas are irregular in shape, and commonly range from 5 to 30 acres or more in size.

Typically, the surface layer is very dark brown, friable silty clay loam about 9 inches thick. The subsurface layer is very dark brown and very dark grayish brown, friable silty clay loam about 10 inches thick. The subsoil is 32 inches thick. The upper part is brown, mottled, friable silty clay loam; the next part is brown and yellowish brown, mottled, firm silty clay loam; and the lower part is grayish brown, yellowish brown, and light brownish gray, mottled, friable silty clay loam. The substratum to a depth of about 60 inches is light brownish gray, mottled, friable silty clay loam.

Included with this soil in mapping are a few small areas of the nearly level, somewhat poorly drained Macksburg soils. These areas make up less than 10 percent of the map unit.

Permeability of this Sharpsburg soil is moderately slow. Surface runoff is medium. Available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium. This soil has good tilth, but tends to puddle if worked when wet.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grains. If cultivated crops are grown, water erosion is a hazard. Water erosion can be adequately controlled in intensively row-cropped areas through a combination of conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, contour farming, contour stripcropping, grassed headlands, terraces, and a cropping rotation that includes grasses and legumes. Grassed waterways help to prevent gully erosion. If terraces are built, topsoil should be stockpiled and spread over the excavated and built-up areas to ease the restoration of productivity. Regular additions of organic material to the soil improve fertility, help to control erosion, maintain good tilth, and increase the rate of water infiltration.

This soil is well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, impairs tilth, and increases the runoff rate. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. In some places terraces are needed to protect critically seeded areas.

The land capability classification is IIe.

370C—Sharpsburg silty clay loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on narrow, convex ridgetops and side slopes on uplands. Areas are long and narrow or irregular in shape, and commonly range from 8 to 25 acres or more in size.

Typically, the surface layer is very dark brown, friable silty clay loam about 9 inches thick. The subsurface layer is very dark brown and dark brown, friable silty clay loam about 7 inches thick. The subsoil is about 35 inches thick. The upper part is brown, friable silty clay loam; the next part is dark yellowish brown, mottled, firm silty clay loam; and the lower part is grayish brown and light brownish gray, mottled, friable silty clay loam. The substratum to a depth of about 60 inches is light brownish gray, mottled, friable silty clay loam. In some places the surface layer is mixed with streaks and pockets of brown subsoil material. Other places are gently sloping.

Included with this soil in mapping are small areas of the Adair and Lamoni soils. The Adair and Lamoni soils have more clay in the subsoil, and formed in a thin mantle of pedisediments or loess and in the underlying paleosol that weathered from glacial till. These soils are on the lower part of the map unit. They make up about 10 percent of the map unit.

Permeability of the Sharpsburg soil is moderately slow. Surface runoff is medium. Available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium. This soil has good tilth, but tends to puddle if worked when wet.

Many areas are in pasture or hayland. Some areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grains. If cultivated crops are grown continuously, soil erosion is a severe hazard. Erosion can be adequately controlled in intensively row-cropped areas through a combination of conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed headlands, terraces, and a cropping rotation that includes grasses and legumes. Grassed waterways help to prevent gully erosion. If terraces are built, topsoil should be stockpiled and spread over the excavated and built-up areas to ease the restoration of productivity. Regular additions of organic material to the soil improve fertility, maintain good tilth, and increase the rate of water infiltration.

This soil is well suited to grasses and legumes for hay and pasture. A cover of hay or pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development and increases runoff. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. In some places terraces are needed to protect critically seeded areas.

The land capability classification is IIIe.

370C2—Sharpsburg silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on narrow, convex ridgetops and side slopes on uplands. Areas are long and narrow or irregular in shape, and commonly range from 5 to 50 acres or more in size.

Typically, the surface layer is very dark brown and very dark grayish brown, friable silty clay loam about 8 inches thick. It is mixed with streaks and pockets of brown subsoil material. The subsoil is about 39 inches thick. The upper part is brown, friable and firm silty clay loam; the next part is dark yellowish brown, mottled, friable silty clay loam; and the lower part is grayish brown and light brownish gray, mottled, friable silty clay loam. The substratum to a depth of about 60 inches is light brownish gray, mottled, friable silty clay loam.

Included with this soil in mapping are small areas of the Adair and Lamoni soils. The Adair and Lamoni soils contain more clay in the subsoil, and formed in a thin mantle of pedisediments or loess and in the underlying paleosol that weathered from glacial till. These soils are on the lower part of the map unit. These areas make up about 10 percent of the map unit.

Permeability of the Sharpsburg soil is moderately slow. Surface runoff is medium. Available water capacity is high. The content of organic matter is about 2.5 or 3.5 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium. This soil has good tilth, but tends to puddle if worked when wet.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grains. If cultivated crops are grown continuously, further erosion is a severe hazard. Erosion can be adequately controlled in intensively row-cropped areas through a combination of conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed headlands, terraces, and a cropping rotation that includes grasses and legumes. Grassed waterways help to prevent gully erosion. If terraces are built, topsoil should be stockpiled and spread over the excavated and built-up areas to ease the restoration of productivity. Regular additions of organic material to the soil improve fertility, maintain good tilth, and increase the rate of water infiltration. This soil generally needs more nitrogen than the uneroded Sharpsburg soils, and requires greater production inputs to maintain higher yields and to maintain or improve tilth.

This soil is well suited to grasses and legumes for hay and pasture. A cover of hay or pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, impairs tilth, and increases runoff. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. In some places terraces are needed to protect critically seeded areas.

The land capability classification is IIIe.

423C2—Bucknell silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, somewhat poorly drained soil is on narrow, convex ridgetops and convex shoulder slopes and side slopes on uplands. Areas are long and narrow or irregular in shape, and commonly range from 5 to 12 acres or more in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 7 inches thick. It is mixed with streaks and pockets of brown and dark grayish brown clay loam subsoil material. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is dark grayish brown, firm clay loam; the next part is gray, yellowish brown, and light gray, very firm clay; and the lower part is yellowish brown, light brownish gray, and yellowish brown, firm clay loam. In some places the clayey horizon is more than 24 inches thick. In small severely eroded areas, the surface layer is mostly dark grayish brown, firm clay loam.

Permeability of this Bucknell soil is slow. Surface runoff is medium. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has fair tilth, and tends to puddle if worked when wet and to crust after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Most areas are used for cultivated crops, hay, or pasture. Areas of this soil generally are farmed along with the adjoining soils. This soil is moderately well suited to corn, soybeans, and small grains. If cultivated crops are grown, further erosion is a severe hazard. Erosion can be adequately controlled for an occasional year of row cropping through a combination of conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed waterways, grassed headlands, terraces, and a cropping rotation that includes grasses and legumes. Installing interceptor tiles in the more permeable soils upslope reduces wetness and allows timelier fieldwork in spring. Regular additions of organic material to the soil improve fertility and tilth, reduce crusting, and increase the rate of water infiltration. This soil generally needs more nitrogen than the uneroded Bucknell soils, and it requires more production inputs to maintain higher yields and to maintain or improve tilth.

This soil is moderately well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay also is effective in controlling erosion. Management may be difficult because this soil tends to be wet and seepy during wet periods. Forage species that tolerate wetness will help to maintain productivity. Installing interceptor tiles on adjacent upslope soils helps to reduce wetness and seepy spots. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

This soil is moderately well suited to trees. The main management concern is the moderate windthrow hazard. The use of silvicultural practices that do not leave widely spaced individual trees will reduce the windthrow hazard. New stands of trees can be easily harvested or planted if species are properly selected and managed.

The land capability classification is IIIe.

423D—Bucknell silty clay loam, 9 to 14 percent slopes. This strongly sloping, somewhat poorly drained soil is on narrow, convex ridgetops and convex shoulder and side slopes on uplands. Areas are long and narrow or irregular in shape, and commonly range from 5 to 20 acres or more in size.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 7 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 5 inches thick. The subsoil is about 39 inches thick, and is mottled. The upper part is brown, firm clay loam; the next part is gray, yellowish brown and light gray, very firm clay; and the lower part is yellowish brown and light brownish gray, firm clay loam. The substratum to a depth of about 60 inches is light brownish gray and yellowish brown, mottled, firm clay loam. In some places the surface layer is very dark gray silty clay loam. In other places it is clay loam.

Permeability of this Bucknell soil is slow. Surface runoff is rapid. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 2.5 to 3.5 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has fair tilth, and tends to puddle if worked when wet and to crust after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Many areas are used for hay and pasture. Some areas are cultivated. This soil is poorly suited to corn and soybeans. It is moderately well suited to small grains. If cultivated crops are grown, erosion is a severe hazard. For an occasional year of row cropping, a combination of conservation practices helps to control erosion. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed waterways, and a cropping rotation that includes grasses and legumes. Installing interceptor tiles in the more permeable soils upslope reduces wetness and allows timelier fieldwork in spring. Regular additions of organic material to the soil improve fertility and tilth, reduce crusting, and increase the rate of water infiltration.

This soil is moderately well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay also is effective in controlling erosion. Management may be difficult because this soil tends to be wet and seepy during wet periods. Forage species that tolerate wetness will help to maintain productivity. The installation of interceptor tiles on adjacent upslope soils helps to reduce wetness and seepy spots. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

This soil is moderately well suited to trees. The main concern of management is the moderate windthrow hazard. The use of silvicultural practices that do not leave widely spaced individual trees will reduce the windthrow hazard. New stands of trees can be easily harvested or planted if species are properly selected and managed.

The land capability classification is IVe.

423D2—Bucknell silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, somewhat poorly drained soil is on narrow, convex ridgetops and convex shoulder and side slopes on uplands. Areas are long and narrow or irregular in shape, and commonly range from 5 to 50 acres or more in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 7 inches thick. It is mixed with streaks and pockets of dark grayish brown subsoil material. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is dark grayish brown, firm silty clay loam; the next part is brown, grayish brown, light gray, and yellowish brown, very firm clay; and the lower part is yellowish brown and light olive gray, firm clay loam. In some places the surface layer is clay loam.

Included in this soil in mapping are small scattered areas throughout the map unit where the surface layer is mostly dark grayish brown, firm clay loam. This soil has very poor tilth, and tends to puddle if worked when wet and to crust after hard rains. It needs more nitrogen than the Bucknell soil. The included soils make up about 10 percent of this map unit.

Permeability of this Bucknell soil is slow. Surface runoff is rapid. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has fair tilth, and tends to puddle and to clod if worked when wet and to crust after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Many areas are cultivated. Some are used for hay and pasture. This soil is poorly suited to corn and soybeans. It is moderately well suited to small grains. If cultivated crops are grown, further water erosion is a severe hazard. For an occasional year of row cropping, a combination of conservation practices helps to control erosion. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed waterways, and a cropping rotation that includes grasses and legumes. Installing interceptor tiles in the more permeable soils upslope reduces wetness and allows timelier fieldwork in spring. Conservation practices upslope that increase infiltration and reduce runoff will also help to control erosion. Regular additions of organic material to the soil improve fertility and tilth, reduce crusting, and increase the rate of water infiltration. This soil generally needs more nitrogen than the uneroded Bucknell soils, and it requires greater production inputs to maintain higher yields and to maintain or improve tilth.

This soil is moderately well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay also is effective in controlling water erosion. Management may be difficult because this soil tends to be wet and seepy during wet periods. Forage species that tolerate wetness will help to maintain productivity. Installation of interceptor tiles on adjacent upslope soils helps to reduce wetness and seepy spots. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

This soil is moderately well suited to trees. The main concern of management is the moderate windthrow hazard. Silvicultural practices that do not leave widely spaced individual trees will reduce the possibility of windthrow hazard. New stands of trees can be easily harvested or planted if species are properly selected and managed.

The land capability classification is IVe.

425D—Keswick loam, 9 to 14 percent slopes. This strongly sloping, moderately well drained soil is on narrow, convex ridgetops and short, convex side slopes and nose slopes on uplands. Areas are long and narrow or irregular in shape, and commonly range from 10 to 100 acres or more in size.

Typically, the surface layer is very dark gray, friable loam about 3 inches thick. The subsurface layer is brown and yellowish brown, friable loam about 6 inches thick. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is yellowish brown, friable loam; the next part is yellowish red, red, strong brown, and gray, very firm clay; and the lower part is yellowish brown, grayish brown, and gray, firm clay loam. In some small places the surface layer is more than 3 inches thick. Some places are moderately sloping.

Permeability of this Keswick soil is slow. Surface runoff is rapid. Available water capacity is moderate. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has fair tilth, and tends to puddle if worked when wet and to crust after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Most areas are woodland or are used for hay and pasture. This soil is poorly suited to corn and soybeans. It is moderately well suited to small grains. If cultivated crops are grown, soil erosion is a severe hazard. For an occasional year of row cropping, a combination of conservation practices helps to control erosion. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, a cropping rotation that includes grasses and legumes, and terraces. If terraces are built, cuts should be held to a minimum depth to avoid exposure of clayey subsoil material. Topsoil should be stockpiled and spread over the excavated and built-up areas to ease restoration of productivity. Grassed waterways help to prevent gully erosion. Conservation practices upslope that increase infiltration and reduce runoff will also help to control erosion. Regular additions of organic material to the soil improve fertility and tilth, reduce crusting, and increase the rate of water infiltration.

This soil is moderately well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay also is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

This soil is moderately well suited to trees, and many areas remain in native hardwood. The main concern of management is the moderate windthrow hazard. Silvicultural practices that do not leave widely spaced individual trees will reduce the possibility of windthrow hazard. New stands of trees can be easily planted or harvested if species are properly selected and managed.

This soil is well suited to use as habitat for woodland wildlife. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas help to maintain or improve the habitat.

The land capability classification is IVe.

425D2—Keswick clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on narrow, convex ridgetops and short, convex side slopes and nose slopes on uplands. Areas are long and narrow or irregular in shape, and commonly range from 5 to 30 acres or more in size.

Typically, the surface layer is dark grayish brown, friable clay loam about 5 inches thick. It is mixed with streaks and pockets of brown and strong brown subsoil material. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is strong brown and red, very firm clay; the next part is yellowish brown, firm clay loam; and the lower part is yellowish brown and light brownish gray, firm clay loam.

Permeability of this Keswick soil is slow. Surface runoff is rapid. Available water capacity is moderate. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 1.5 to 2.5 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has poor tilth, and tends to puddle and to clod if worked when wet and to crust after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Many areas are used for cultivated crops, hay, and pasture. Some areas are woodland. This soil is poorly suited to corn and soybeans. It is moderately well suited to small grains. If cultivated crops are grown, further erosion is a severe hazard. For an occasional year of row cropping, a combination of conservation practices helps to control erosion. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, a cropping rotation that includes grasses and legumes, and terraces. If terraces are built, cuts should be held to a minimum depth to avoid exposure of clayey subsoil material. Topsoil should be stockpiled and spread over the excavated and built-up areas to ease the restoration of productivity. Grassed waterways help to prevent gully erosion. Conservation practices upslope that increase infiltration and reduce runoff will help to control erosion. Regular additions of organic material to the soil improve fertility and tilth, reduce crusting, and increase the rate of water infiltration. This soil generally needs more nitrogen than the uneroded Keswick soils, and it requires greater production inputs to maintain higher yields and to maintain or improve tilth.

This soil is moderately well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay also is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

This soil is moderately well suited to trees. The main concern of management is the moderate windthrow hazard. Silvicultural practices that do not leave widely spaced individual trees will reduce the windthrow hazard. New stands of trees can be easily planted or harvested if species are properly selected and managed.

This soil is well suited to use as habitat for woodland wildlife. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas help to maintain or improve the habitat.

The land capability classification is IVe.

430—Ackmore silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained or poorly drained soil is on flood plains and alluvial fans along the major streams. It is subject to flooding. Areas are irregular in shape, and commonly range from 5 to 40 or more acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 8 inches thick. The substratum is stratified dark grayish brown, grayish brown, very dark grayish brown, and very dark gray, mottled, friable silt loam about 17 inches thick. The layer below that, to a depth of about 60 inches, is a buried surface soil of black and very dark gray, friable silty clay loam, and is mottled in the lower part. In some areas the buried surface soil is at a depth of 12 inches.

Permeability of the Ackmore soil is moderate. Surface runoff is slow. Available water capacity is high. The soil has a seasonal high water table at depth of 1 to 3 feet. The content of organic matter is about 1 to 3 percent in the surface layer. The substratum generally has a low supply of available phosphorus and a very low supply of available potassium. This soil has good tilth, but tends to puddle if worked when wet.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grains. Row crops can be grown in many years if the soil is adequately drained and protected from floodwater. Subsurface drainage lowers the water table and allows timelier fieldwork. Surface drains are commonly used to remove excess surface water. In many areas, diversion terraces are needed to protect the soil from the runoff from the higher surrounding areas and levees and dikes may be needed to provide flood protection from the overflow of streams. Leaving crop residue on the surface and regular additions of organic material to the soil reduce the susceptibility to soil blowing, improve fertility, maintain good tilth, prevent crusting, and increase the rate of water infiltration.

This soil is well suited to grasses and legumes for hay and pasture. Some areas that are frequently flooded or are dissected by old streams are in permanent pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, impairs tilth, and causes puddling of the soil. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland.

This soil is well suited to trees, and a few small areas remain in native hardwoods. New stands of trees can be easily harvested or planted if species are properly selected and managed.

The land capability classification is IIw.

452C2—Lineville silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on short, convex side slopes, convex ridgetops, and convex nose slopes on uplands. Areas are long and narrow or irregular in shape, and commonly range from 3 to 15 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 7 inches thick. It is mixed with streaks and pockets of brown subsoil material. The subsoil extends to a depth of about 60 inches or more. The upper part is brown, friable and firm silty clay loam and has grayish brown mottles in the lower part; the next part is yellowish brown, dark grayish brown, and grayish brown, mottled, firm clay loam; and the lower part is strong brown and yellowish red, mottled, firm and very firm clay loam and clay. In some small, uneroded areas the surface layer is very dark gray or very dark grayish brown, friable silt loam about 8 inches thick.

Included with this soil in mapping are small areas of Ladoga and Pershing soils upslope on broader ridgetops. These soils formed in loess, and contain less sand in the surface layer and subsoil than the Lineville soil. These soils make up 5 to 10 percent of this map unit.

Permeability of the Lineville soil is slow. Surface runoff is medium. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has fair tilth, and tends to puddle if worked when wet and to crust after hard rains. Seedling development is retarded if crusting occurs prior to seedling emergence.

Most areas are used for cultivated crops, hay, or pasture. Areas of this soil generally are farmed along with the adjoining soils. This soil is moderately well suited to corn, soybeans, and small grains. If cultivated crops are grown, soil erosion is a severe hazard. A combination of conservation practices helps to control erosion. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed waterways, a cropping rotation that includes grasses and legumes, and terraces. If terraces are built, topsoil should be stockpiled and spread over the excavated and built-up areas to ease the restoration of productivity. Regular additions of organic material to the soil improve fertility and tilth, reduce crusting, and increase the rate of water infiltration.

This soil is well suited to grasses and legumes for hay and pasture. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. In some places terraces may be needed to protect critically seeded areas.

This soil is well suited to trees, and a few small areas remain in native hardwood. New stands of trees can be easily harvested or planted if species are properly selected and managed.

The land capability classification is IIIe.

484—Lawson silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on bottom land along major streams. It is subject to flooding. Areas are long and narrow or irregular in shape, and commonly range from 8 to 50 acres in size.

Typically, the surface layer is very dark brown, friable silt loam about 9 inches thick. The subsurface layer is friable silt loam about 21 inches thick, and is mottled. It is very dark brown in the upper part and very dark grayish brown in the lower part. The substratum to a depth of about 60 inches is very dark grayish brown and dark grayish brown, mottled, friable silt loam.

Included with this soil in mapping are small scattered areas of the poorly drained Colo soils. These soils are higher in content of clay than the Lawson soil. They make up 5 to 10 percent of the map unit.

Permeability of the Lawson soil is moderate. Surface runoff is slow. Available water capacity is very high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The content of organic matter is about 4.5 to 6.0 percent in the surface layer. This soil generally has a medium supply of available phosphorus and a low supply of available potassium. It has good tilth.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grains. Row crops can be grown in many years if the soil is adequately drained and protected from floodwater. A subsurface drainage system lowers the water table and allows timelier fieldwork. Surface drains are commonly used to remove excess surface water. In many areas, diversion terraces are needed to protect the soil from the runoff from the higher surrounding areas and levees and dikes may be needed to provide flood protection from the overflow of streams. Leaving crop residue on the surface and regularly adding organic material to the soil reduces the susceptibility to soil blowing, improves fertility, maintains good tilth, prevents crusting, and increases the rate of water infiltration.

This soil is well suited to grasses and legumes for hay and pasture. Some areas that are narrow or are dissected by old streams are in permanent pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, impairs tilth, and causes puddling of the soil. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland.

This soil is well suited to trees, and a few small areas remain in native hardwoods. New stands of trees can be easily harvested or planted if species are properly selected and managed.

The land capability classification is IIw.

570C—Nira silty clay loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on short, convex ridgetops and convex to straight side slopes on uplands. Areas are long and narrow or irregular in shape, and commonly range from 5 to 20 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 9 inches thick. The subsurface layer is very dark gray and very dark grayish brown, friable silty clay loam about 3 inches thick. The subsoil is mottled, friable silty clay loam about 36 inches thick. The upper part is brown, the next part is brown and grayish brown, and the lower part is olive gray and light olive gray. The substratum to a depth of about 60 inches is light olive gray, mottled, friable silt loam. In some places the upper part of the subsoil is dark grayish brown. In other areas the surface layer is mixed with streaks and pockets of brown subsoil material.

Permeability of this Nira soil is moderate. Surface runoff is medium. Available water capacity is high. The soil has a seasonal high water table at a depth of 4 to 6 feet. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium. This soil has good tilth, but tends to puddle if worked when wet.

Many areas are cultivated. Some areas are used for hay and pasture. This soil is moderately well suited to corn, soybeans, and small grains. If cultivated crops are grown, water erosion is a hazard. In intensively row-cropped areas a combination of conservation practices helps to control erosion. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour stripcropping, contour farming, grassed headlands, a cropping rotation that includes grasses and legumes, and terraces. If terraces are built, topsoil should be stockpiled and spread over the excavated and built-up areas to ease the restoration of productivity. Grassed waterways help to control gully erosion. Regular additions of organic material to the soil improve fertility, maintain good tilth, and increase the rate of water infiltration.

This soil is well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay also is effective in controlling water erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

The land capability classification is IIIe.

570C2—Nira silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on short, convex ridgetops and convex to straight side slopes on uplands. Areas are long and narrow or irregular in shape, and commonly range from 5 to 40 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 8 inches thick. It is mixed with streaks and pockets of brown subsoil material. The subsoil is mottled, friable silty clay loam about 37 inches thick. The upper part is brown, the next part is grayish brown, and the lower part is light brownish gray. The substratum to a depth of about 60 inches is light olive gray, mottled, friable silty clay loam. In some places the upper part of the subsoil is dark grayish brown.

Permeability of this Nira soil is moderate. Surface runoff is medium. Available water capacity is high. The soil has a seasonal high water table at a depth of 4 to 6 feet. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium. This soil has good tilth, but tends to puddle if worked when wet.

Many areas are cultivated. Some areas are used for hay and pasture. This soil is moderately well suited to corn, soybeans, and small grains. If cultivated crops are grown, further erosion is a severe hazard. In intensively row-cropped areas a combination of conservation practices helps to control erosion. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour stripcropping, contour farming, grassed headlands, a cropping rotation that includes grasses and legumes, and terraces. If terraces are built, topsoil should be stockpiled and spread over the excavated and built-up areas to ease the restoration of productivity. Grassed waterways help to control gully erosion. Regular additions of organic material to the soil improve fertility, maintain good tilth, and increase the rate of water infiltration. This soil generally needs more nitrogen than the uneroded Nira soils, and it requires greater production inputs to maintain higher yields and to maintain or improve tilth.

This soil is well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay also is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

The land capability classification is IIIe.

592C2—Mystic clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained and somewhat poorly drained soil is on convex ridgetops and side slopes of high stream terraces. Areas are long and narrow or irregular in shape, and commonly range from 5 to 20 acres in size.

Typically, the surface layer is very dark grayish brown, friable clay loam about 7 inches thick. It is mixed with streaks and pockets of brown subsoil material. The subsoil is about 48 inches thick, and is mottled. The upper part is brown, yellowish brown, and grayish brown, very firm clay; the next part is grayish brown, firm clay; and the lower part is grayish brown and strong brown, friable clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, friable clay loam. In some small uneroded areas, the surface layer is very dark gray or very dark grayish brown silt loam or loam about 8 inches thick. In other small severely eroded areas, the surface layer is mostly brown clay loam. In places the subsoil has less clay and does not have red colors.

Permeability of this Mystic soil is slow. Surface runoff is medium. Available water capacity is high. The soil has a seasonal high water table at a depth of 3 to 5 feet, and has seepy spots during wet periods. The shrink-swell potential is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium. This soil has fair tilth, and tends to puddle and to clod if worked when wet and to crust after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Most areas are used for cultivated crops, hay, and pasture. This soil is moderately well suited to corn, soybeans, and small grains. If this soil is used for row crops, further erosion is a severe hazard. For occasional row cropping, a combination of conservation practices adequately controls erosion. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, grassed waterways, contour farming, contour stripcropping, a cropping rotation that includes grasses and legumes, and terraces. Regularly adding organic material to the soil improves fertility and tilth, reduces crusting, and increases the rate of water infiltration. This soil generally needs more nitrogen than the uneroded Mystic soils, and requires greater production inputs to maintain higher yields and to maintain or improve tilth.

This soil is moderately well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay also is effective in controlling erosion. Management may be difficult because this soil tends to be wet and seepy during wet periods. Forage species that tolerate wetness will help to maintain productivity. Installing interceptor tiles on adjacent upslope soils helps to reduce wetness and seepy spots. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

This soil is well suited to trees, and a few small areas remain in native hardwoods. New stands of trees can be easily harvested or planted if species are properly selected and managed.

The land capability classification is IIIe.

592D2—Mystic clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained and somewhat poorly drained soil is on convex ridgetops and side slopes of high stream terraces. Areas are long and narrow or irregular in shape, and commonly range from 4 to 16 acres in size.

Typically, the surface layer is very dark grayish brown, friable clay loam about 7 inches thick. It is mixed with streaks and pockets of brown subsoil material. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is brown and grayish brown, firm clay loam; the next part is grayish brown and red, very firm clay; and the lower part is strong brown and yellowish brown, firm clay loam and sandy clay loam. In some small uneroded areas, the surface layer is very dark gray or very dark grayish brown silt loam or loam about 8 inches thick. In other small severely eroded areas, the surface layer is mostly brown clay loam.

Permeability of this Mystic soil is slow. Surface runoff is rapid. Available water capacity is high. The soil has a seasonal high water table at a depth of 3 to 5 feet, and has seepy spots during wet periods. The shrink-swell potential is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium. This soil has fair tilth, and tends to puddle and to clod if worked when wet and to crust after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Most areas are used for cultivated crops, hay, or pasture. This soil is poorly suited to corn and soybeans. It is best suited to small grains and to grasses and legumes for hay and pasture. The tillage of row crops creates a severe hazard of further erosion. Row crops can be grown some of the time if erosion protection is adequate. For an occasional year of row cropping, a combination of soil conservation practices helps to control erosion. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, grassed waterways, contour farming, contour stripcropping, a cropping rotation that includes grasses and legumes, and terraces. Regularly adding organic material to the soil improves fertility and tilth, reduces crusting, and increases the rate of water infiltration. This soil generally needs more nitrogen than the uneroded Mystic soils, and requires greater production inputs to maintain higher yields and to maintain or improve tilth.

This soil is moderately well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay also is effective in controlling erosion. Management may be difficult because this soil tends to be wet and seepy during wet periods. Forage species that tolerate wetness will help to maintain productivity. Installing interceptor tiles on adjacent upslope soils helps to reduce wetness and seepy spots. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

This soil is well suited to trees, and a few small areas remain in native hardwoods. New stands of trees can be easily harvested or planted if species are properly selected and managed.

The land capability classification IVe.

730C—Cantril-Nodaway complex, 0 to 9 percent slopes. These nearly level to moderately sloping soils are in narrow drainageways and on narrow foot slopes. The somewhat poorly drained Cantril soil is on the upper part of slopes. The moderately well drained Nodaway soil is on the lower part nearer the stream channels, and is subject to flooding. It is in the nearly level part of this map unit. Individual areas of the Cantril and Nodaway soils are long and narrow, and commonly range from 10 to 80 acres in size. They are about 60 percent Cantril soil, 30 percent Nodaway soil, and 10 percent other soils. These areas are so narrow and small that mapping them separately is not practical.

Typically, the surface layer of the Cantril soil is very dark gray, friable loam about 7 inches thick. The subsurface layer is dark grayish brown, friable loam about 3 inches thick. The subsoil extends to a depth of about 60 inches or more. The upper part is grayish brown and yellowish brown, mottled, friable clay loam, and the lower part is dark grayish brown, mottled, firm clay loam.

Typically, the surface layer of the Nodaway soil is very dark gray and very dark grayish brown, friable silt loam about 9 inches thick. The substratum to a depth of about 60 inches is stratified dark grayish brown, very dark grayish brown, grayish brown, and very dark gray, mottled, friable silt loam. In some places the surface layer is loam, silty clay loam, or sandy loam.

Included with these soils in mapping are some small areas of Zook soils between the Cantril and Nodaway soils in the nearly level part of this map unit. The Zook soils are poorly drained, and make up about 10 percent of the map unit.

Permeability of the Cantril and Nodaway soils is moderate. Surface runoff is medium on the Cantril soil and is slow on the Nodaway soil. Available water capacity is high in the Cantril soil and very high in the Nodaway soil. These soils have a seasonal high water table. The content of organic matter is about 2 to 3 percent in the surface layer of the Cantril soil. The Cantril soil has a very low supply of available phosphorus and potassium in the subsoil. The content of organic matter is about 1 to 2 percent in the surface layer of the Nodaway soil. The Nodaway soil has a medium supply of available phosphorus and very low supply of available potassium in the substratum. The soils in this map unit have fair tilth, and tend to puddle if worked when wet.

Most areas are woodland. A few areas are in permanent pasture. These areas are poorly suited to corn, soybeans, and small grains because they are so narrow and long, are adjacent to steep or very steep sloping areas, and are dissected by gullies and uncrossable waterways. Permanent pasture or woodland vegetation should be maintained to prevent further gully erosion.

These soils are suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, suitable forage selection, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland.

These soils are suited to trees. Many areas remain in native hardwoods, and provide good habitat for wildlife. New stands of trees can be easily harvested or planted if species are properly selected and managed.

The land capability classification is IIIe.

792C—Armstrong loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained and somewhat poorly drained soil is on short, convex side slopes, narrow, convex ridgetops, and convex nose slopes on uplands. Areas are long and narrow or irregular in shape, and commonly range from 5 to 20 acres or more in size.

Typically, the surface layer is very dark gray and very dark grayish brown, friable loam about 8 inches thick. The subsurface layer is dark grayish brown, friable loam about 4 inches thick. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is dark yellowish brown, firm clay loam; the next part is strong brown, brown, and grayish brown, very firm clay; and the lower part is yellowish brown and light brownish gray, firm clay loam.

Permeability of this Armstrong soil is slow. Surface runoff is medium. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 2.5 to 3.5 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has good tilth, but tends to puddle if worked when wet and to crust after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Most areas are used for hay, pasture, or woodland. This soil is moderately well suited to corn, soybeans, and small grains. If cultivated crops are grown, soil erosion is a severe hazard. For occasional row crops, a combination of conservation practices helps to control erosion. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed waterways, a cropping rotation that includes grasses and legumes, and terraces. Regular additions of organic material to the soil improve fertility, maintain good tilth, prevent crusting, and increase the rate of water infiltration.

This soil is moderately well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay also is effective in controlling erosion. Management may be difficult because this soil tends to be wet and seepy during wet periods. Forage species that tolerate wetness will help to maintain productivity. Installing interceptor tiles on adjacent upslope soils helps to reduce wetness and seepy spots. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

This soil is moderately well suited to trees, and a few small areas remain in native hardwoods. Seedling mortality and the windthrow hazard are the main management concerns. Natural and planted seedlings do not survive well. Seedlings should be planted closer together. The surviving trees can then be thinned later to achieve the desired stand density. Silvicultural practices that do not leave widely spaced individual trees will reduce the windthrow hazard. Other limitations or hazards that affect planting or harvesting trees are slight.

The land capability classification is IIIe.

792C2—Armstrong clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained and somewhat poorly drained soil is on short, convex side slopes and narrow, convex ridgetops and nose slopes on uplands. Areas are long and narrow or irregular in shape, and commonly range from 5 to 25 acres in size.

Typically, the surface layer is very dark gray, friable clay loam about 7 inches thick. It is mixed with streaks and pockets of brown subsoil material. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is brown, firm clay loam; the next part is strong brown and reddish brown, very firm clay; and the lower part is yellowish brown and light brownish gray, firm clay loam.

Permeability of this Armstrong soil is slow. Surface runoff is medium. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has fair tilth, and tends to puddle if worked when wet and to crust after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Many areas are cultivated. Some areas are used for hay and pasture. This soil is moderately well suited to corn, soybeans, and small grains. If cultivated crops are grown, further erosion is a severe hazard. For occasional row crops, a combination of conservation practices helps to control erosion. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed waterways, a cropping rotation that includes grasses and legumes, and terraces. Regularly adding organic material to the soil improves fertility and tilth, reduces crusting, and increases the rate of water infiltration. This soil generally needs more nitrogen than the uneroded Armstrong soils, and it requires greater production inputs to maintain higher yields and to improve tilth.

This soil is moderately well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay also is effective in controlling erosion. Management may be difficult because this soil tends to be wet and seepy during wet periods. Forage species that tolerate wetness will help to maintain productivity.

Installing interceptor tiles on adjacent upslope soils helps to reduce wetness and seepy spots. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

This soil is moderately well suited to trees, and a few small areas remain in native hardwoods. Seedling mortality and windthrow hazard are the main management concerns. Natural and planted seedlings do not survive well. Seedlings should be planted closer together. The surviving trees can then be thinned later to achieve the desired stand density. Silvicultural practices that do not leave widely spaced individual trees will reduce the possibility of windthrow hazard. Other limitations or hazards that affect planting or harvesting trees are slight.

The land capability classification is IIIe.

792D—Armstrong loam, 9 to 14 percent slopes. This strongly sloping, moderately well drained and somewhat poorly drained soil is on short, convex side slopes and narrow, convex ridgetops and nose slopes on uplands. Areas are long and narrow or irregular in shape, and commonly range from 5 to 60 acres in size.

Typically, the surface layer is very dark gray and very dark grayish brown, friable loam about 7 inches thick. The subsurface layer is dark grayish brown and yellowish brown, mottled, friable loam about 5 inches thick. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is brown and strong brown, very firm clay, and the lower part is yellowish brown, firm clay loam. In some places the surface layer is mixed with streaks and pockets of brown clay loam subsoil material.

Permeability of this Armstrong soil is slow. Surface runoff is rapid. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 2.5 to 3.5 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has good tilth, but tends to puddle if worked when wet and to crust after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Many areas are used for hay, pasture, or woodland. Some areas are cultivated. This soil is poorly suited to corn and soybeans. It is moderately well suited to small grains and to grasses and legumes for hay and pasture. If row crops are grown, water erosion is a severe hazard. For occasional row crops, a combination of conservation practices helps to control erosion. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed waterways, grassed headlands, terraces, and a cropping rotation that includes grasses and legumes. Regularly adding organic material to the soil improves fertility, maintains good tilth, prevents crusting, and increases the rate of water infiltration.

This soil is best suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay also is effective in controlling water erosion. Management may be difficult because this soil tends to be wet and seepy during wet periods. Forage species that tolerate wetness will help to maintain productivity. Installing interceptor tiles on adjacent upslope soils helps to reduce wetness and seepy spots. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

This soil is moderately well suited to trees, and some areas remain in native hardwoods. Seedling mortality and windthrow hazard are the main management concerns. Natural and planted seedlings do not survive well. Seedlings should be planted closer together. The surviving trees can then be thinned later to achieve the desired stand density. Silvicultural practices that do not leave widely spaced individual trees will reduce the windthrow hazard. Other limitations or hazards that affect planting or harvesting trees are slight.

The land capability classification is IVe.

792D2—Armstrong clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained and somewhat poorly drained soil is on short, convex side slopes and on narrow, convex ridgetops and nose slopes on uplands. Areas are long and narrow or irregular in shape, and commonly range from 5 to 50 acres in size.

Typically, the surface layer is very dark gray, friable clay loam about 7 inches thick. It is mixed with streaks and pockets of brown subsoil material. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is brown, firm clay loam; the next part is strong brown and yellowish brown, very firm clay; and the lower part is yellowish brown, grayish brown, and light brownish gray, firm clay loam.

Included with this soil in mapping are scattered small areas where the surface layer is mostly brown clay loam, has poor tilth, and requires more fertilizer. These areas make up 10 to 15 percent of the map unit.

Permeability of this Armstrong soil is slow. Surface runoff is rapid. Available water capacity is moderate. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has fair tilth, and tends to puddle if worked when wet and to crust after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Most areas are used for cultivated crops, hay, or pasture. This soil is poorly suited to corn and soybeans. It is moderately well suited to small grains and to grasses and legumes for hay and pasture. If row crops are grown, further erosion is a severe hazard. For occasional row crops, a combination of soil conservation practices helps to control erosion. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed waterways, terraces, and a cropping rotation that includes grasses and legumes. Regularly adding organic material improves fertility and tilth, reduces crusting, and increases the rate of water infiltration. This soil generally needs more nitrogen than the uneroded Armstrong soils, and requires greater production inputs to maintain higher yields and to improve tilth.

This soil is best suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay also is effective in controlling erosion. Management may be difficult because this soil tends to be wet and seepy during wet periods. Forage species that tolerate wetness will help to maintain productivity. Installing interceptor tiles on adjacent upslope soils helps to reduce wetness and seepy spots. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

This soil is moderately well suited to trees, and a few small areas remain in native hardwoods. Seedling mortality and windthrow hazard are the main management concerns. Natural and planted seedlings do not survive well. Seedlings should be planted closer together. The surviving trees can then be thinned later to achieve the desired stand density. Silvicultural practices that do not leave widely spaced individual trees will reduce the windthrow hazard. Other limitations or hazards that affect planting or harvesting trees are slight.

The land capability classification is IVe.

792D3—Armstrong clay loam, 9 to 14 percent slopes, severely eroded. This strongly sloping, moderately well drained and somewhat poorly drained soil is on short, convex side slopes and on narrow, convex ridgetops and nose slopes on uplands. Areas are long and narrow or irregular in shape, and commonly range from 5 to 20 acres in size.

Typically, the surface layer is brown, firm clay loam about 7 inches thick. It is mixed with 15 to 20 percent streaks and pockets of very dark grayish brown loam material from the original surface layer. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is strong brown and yellowish red, very firm clay, and the lower part is strong brown, yellowish brown, and grayish brown, firm clay loam.

Permeability of this Armstrong soil is slow. Surface runoff is rapid. Available water capacity is moderate. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 1.5 to 2.5 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has poor tilth, and tends to puddle and to clod if worked when wet and to crust after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Most areas are cultivated. Some areas are used for hay and pasture. In most areas these soils are managed along with the adjacent soils. Because of the slope and the severe hazard of further erosion, this soil generally is unsuited to corn, soybeans, and small grains. It is best suited to grasses and legumes for hay and pasture. A permanent cover of pasture plants or hay also is effective in controlling further erosion. Management may be difficult because this soil tends to be wet and seepy during wet periods. Forage species that tolerate wetness will help to maintain productivity. The installation of interceptor tiles on adjacent upslope soils helps to reduce wetness and seepy spots. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

This soil is moderately well suited to trees, and a few small areas remain in native hardwoods. Seedling mortality and windthrow hazard are the main management concerns. Natural and planted seedlings do not survive well. Seedlings should be planted closer together. The surviving trees can then be thinned later to achieve the desired stand density. Silvicultural practices that do not leave widely spaced individual trees will reduce the windthrow hazard. Other limitations or hazards that affect planting or harvesting trees are slight.

The land capability classification is Vle.

822C—Lamoni clay loam, 5 to 9 percent slopes. This moderately sloping, somewhat poorly drained soil is on convex side slopes and narrow, convex ridgetops on uplands. Areas are long and narrow or irregular in shape, and commonly range from 5 to 25 acres in size.

Typically, the surface layer is black, friable clay loam about 9 inches thick. The subsurface layer is very dark gray, friable clay loam about 3 inches thick. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is dark grayish brown, firm clay loam; the next part is grayish brown, very firm clay; and the lower part is yellowish brown and light brownish gray, firm clay loam. In some places the surface layer is mixed with streaks and pockets of brown subsoil material.

Permeability of this Lamoni soil is slow. Surface runoff is medium. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium. This soil has good tilth.

Most areas are used for cultivated crops, hay, or pasture. This soil is moderately well suited to corn and soybeans. It is well suited to small grains. If row crops are grown, erosion is a severe hazard. A combination of conservation practices helps to control erosion. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed waterways, grassed headlands, a cropping rotation that includes grasses and legumes, and terraces. Regular additions of organic material to the soil improve fertility, maintain good tilth, and increase the rate of water infiltration.

This soil is well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay is effective in controlling erosion. Management may be difficult because this soil tends to be wet and seepy during wet periods. Forage species that tolerate wetness will help to maintain productivity. Installing interceptor tiles on adjacent upslope soils helps to reduce wetness and seepy spots. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

The land capability classification is IIIe.

822C2—Lamoni clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, somewhat poorly drained soil is on convex side slopes and narrow, convex ridgetops on uplands. Areas are long and narrow or irregular in shape, and commonly range from 5 to 40 acres in size.

Typically, the surface layer is very dark gray, friable clay loam about 8 inches thick. It is mixed with streaks and pockets of dark grayish brown subsoil material. The subsoil is about 49 inches thick, and is mottled. The upper part is firm clay loam; the next part is grayish brown, very firm clay; and the lower part is gray and yellowish brown, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown and gray, mottled, firm clay loam.

Permeability of this Lamoni soil is slow. Surface runoff is medium. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium. This soil has good tilth, but tends to puddle if worked when wet.

Most areas are cultivated. This soil is moderately well suited to corn and soybeans. It is well suited to small grains. If row crops are grown, further water erosion is a severe hazard. Water erosion can be adequately controlled through a combination of conservation practices. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed waterways, grassed headlands, a cropping rotation that includes grasses and legumes, and terraces. Regular additions of organic material to the soil improve fertility and tilth and increase the rate of water infiltration. This soil generally needs more nitrogen than the uneroded Lamoni soils, and it requires greater production inputs to maintain higher yields and to maintain or improve tilth.

This soil is well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay is effective in controlling water erosion. Management may be difficult because this soil tends to be wet and seepy during wet periods. Forage species that tolerate wetness will help to maintain productivity. Installing interceptor tiles on adjacent upslope soils helps to reduce wetness and seepy spots. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

The land capability classification is IIIe.

822C3—Lamoni clay loam, 5 to 9 percent slopes, severely eroded. This moderately sloping, somewhat poorly drained soil is on convex side slopes and on narrow, convex ridgetops on uplands. Areas are long and narrow or irregular in shape, and commonly range from 5 to 20 acres in size.

Typically, the surface layer is brown, firm clay loam about 7 inches thick. It has 20 to 25 percent streaks and pockets of black material from the original surface layer. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is dark grayish brown and grayish brown, very firm clay; the next part is yellowish brown and gray, firm clay loam; and the lower part is yellowish brown and light brownish gray, firm clay loam.

Permeability of this Lamoni soil is slow. Surface runoff is medium. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 1.5 to 2.5 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium. This soil has poor tilth, and tends to puddle and to clod if worked when wet and to crust after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Most areas are cultivated. This soil is poorly suited to corn and soybeans. It is moderately well suited to small grains and to grasses and legumes for hay and pasture. If row crops are grown, further soil erosion is a severe hazard. For an occasional year of row crops, a combination of conservation practices helps to control erosion. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed waterways, and a cropping rotation that includes grasses and legumes. Regular additions of organic material to the soil improve fertility and tilth, reduce crusting, and increase the rate of water infiltration. This soil generally needs more nitrogen than the less eroded Lamoni soils, and it requires greater production inputs to maintain higher yields and to improve tilth.

This soil is best suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay is effective in controlling erosion. Management of pasture or hayland may be difficult because this soil tends to be wet and seepy during wet periods. Forage species that tolerate wetness will help to maintain productivity. Installing interceptor tiles on adjacent upslope soils helps to reduce wetness and seepy spots. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

The land capability classification is IVe.

822D—Lamoni clay loam, 9 to 14 percent slopes. This strongly sloping, somewhat poorly drained soil is on convex side slopes and narrow, convex ridgetops on uplands. Areas are long and narrow or irregular in shape, and commonly range from 5 to 25 acres in size.

Typically, the surface layer is black, friable clay loam about 10 inches thick. The subsurface layer is very dark gray and very dark grayish brown, friable clay loam about 4 inches thick. The subsoil is about 38 inches thick, and is mottled. The upper part is dark grayish brown, firm clay loam; the next part is grayish brown, yellowish brown, and light gray, very firm clay; and the lower part is yellowish brown and light gray, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown and light gray, mottled, friable clay loam. In some places the surface layer is mixed with streaks and pockets of dark grayish brown subsoil material. Also, in places the subsoil contains less clay and is browner.

Permeability of this Lamoni soil is slow. Surface runoff is rapid. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium. This soil has good tilth.

Most areas are used for cultivated crops, hay, or pasture. This soil is moderately well suited to corn, soybeans, and small grains. It is moderately well suited to grasses and legumes for hay and pasture. If row crops are grown, erosion is a severe hazard. For occasional row crops, a combination of conservation practices helps to control erosion. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed waterways, terraces, and a cropping rotation that includes grasses and legumes. Regular additions of organic material to the soil improve fertility, maintain good tilth, and increase the rate of water infiltration.

This soil is best suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay is effective in controlling erosion. Management of pasture or hayland may be difficult because this soil tends to be wet and seepy during wet periods. Forage species that tolerate wetness will help to maintain productivity. Installing interceptor tiles on adjacent upslope soils helps to reduce wetness and seepy spots. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

The land capability classification is IVe.

822D2—Lamoni clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, somewhat poorly drained soil is on convex side slopes and narrow, convex ridgetops on uplands. Areas are long and narrow or irregular in shape, and commonly range from 5 to 60 acres or more in size.

Typically, the surface layer is very dark gray, friable clay loam about 7 inches thick. It is mixed with streaks and pockets of dark grayish brown subsoil material. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is dark grayish brown, firm clay loam; the next part is grayish brown, gray, and yellowish brown, very firm clay; and the lower part is yellowish brown and light gray, firm clay loam. In some places the surface layer and subsurface layer are black and very dark gray clay loam and are 10 or more inches thick. Also, in some places the subsoil contains less clay and is browner.

Permeability of this Lamoni soil is slow. Surface runoff is rapid. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of potassium. This soil has fair tilth, and tends to puddle if worked when wet.

Most areas are cultivated. This soil is poorly suited to corn and soybeans. This soil is moderately well suited to small grains and to grasses and legumes for hay and pasture. If row crops are grown, further erosion is a severe hazard. For occasional row crops, a combination of conservation practices helps to control erosion. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed waterways, terraces, and a cropping rotation that includes grasses and legumes. Regular additions of organic material to the soil improve fertility and tilth and increase the rate of water infiltration. This soil generally needs more nitrogen than the uneroded Lamoni soils, and it requires greater production inputs to maintain higher yields and to improve tilth.

This soil is best suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay is effective in controlling erosion. Management of pasture and hayland may be difficult because this soil tends to be wet and seepy during wet periods. Forage species that tolerate wetness will help to maintain productivity. Installing interceptor tiles on adjacent upslope soils helps to reduce wetness and seepy spots. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

The land capability classification is IVe.

822D3—Lamoni clay loam, 9 to 14 percent slopes, severely eroded. This strongly sloping, somewhat poorly drained soil is on convex side slopes, narrow, convex ridgetops, and nose slopes on uplands. Areas are long and narrow or irregular in shape, and commonly range from 5 to 10 acres in size.

Typically, the surface layer is brown, firm clay loam about 7 inches thick. It has 20 to 25 percent streaks and pockets of very dark gray material from the original surface layer. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is dark grayish brown and grayish brown, very firm clay; the next part is grayish brown and yellowish brown, firm clay loam; and the lower part is yellowish brown and light brownish gray, firm clay loam. In some places the surface layer is very dark gray, friable clay loam about 8 inches thick and is mixed with streaks and pockets of brown subsoil material.

Permeability of this Lamoni soil is slow. Surface runoff is rapid. Available water capacity is high. The soil has a seasonal high water table at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 1 or 2 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium. This soil has poor tilth, and tends to puddle and to clod if worked when wet and to crust after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Most areas are cultivated. Some areas are used for hay and pasture. In most areas these soils are managed along with the adjacent soils. Because of the slope and the severe hazard of further erosion, this soil generally is unsuited to corn, soybeans, and small grains. This soil is moderately well suited to grasses and legumes for hay and pasture. A permanent cover of pasture plants or hay is effective in controlling further soil erosion.

Managing pasture and hayland may be difficult because this soil is wet and seepy during wet periods and has poor tilth. Proper tile drainage placement on adjacent soils above the seep line will also help legume crops for hay as well as grasses for pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces forage production, and increases runoff.

Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in fair condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the hazard of further erosion, and results in a minimum loss of grazing or hay production during the seeding year.

The land capability classification is VIe.

892C2—Mystic Variant silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, poorly drained soil is on convex side slopes and ridgetops of high stream terraces. Areas are long and narrow or irregular in shape, and commonly range from 5 to 20 acres in size.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 8 inches thick. It is mixed with streaks and pockets of grayish brown subsoil material. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is grayish brown, very firm silty clay; the next part is dark gray and gray, very firm and firm silty clay; and the lower part is light gray and grayish brown, firm and friable clay loam. In some areas the slopes are steeper.

Permeability of the Mystic Variant soil is very slow. Surface runoff is medium. Available water capacity is high. This soil has a seasonal high water table at a depth of 1 to 3 feet, and has wet and seepy spots during wet periods. The shrink-swell potential is high. The content of organic matter is about 1 to 2 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. This soil has poor tilth, and tends to puddle and to clod if worked when wet and to crust after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Most areas are used for pasture, hay, or row crops. This soil is poorly suited to corn, soybeans, and small grains. It is moderately well suited to grasses and legumes for hay and pasture. If this soil is used for row crops, wetness is a very serious limitation and further erosion is a severe hazard. Tile drainage is not feasible on this very slowly permeable soil. Installing interceptor tiles upslope in the adjacent soil helps to reduce wetness and seepy spots on this soil. For occasional row crops, a combination of conservation practices helps to control erosion. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed waterways, and a cropping rotation that includes grasses and legumes. Regular additions of organic material to the soil improve fertility and tilth, reduce crusting, and increase the rate of water infiltration.

This soil is best suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay is also effective in controlling soil erosion. Management of pasture and hayland may be difficult because this soil is wet and seepy in spring and early summer. Forage species that tolerate wetness will help to maintain productivity. Installing interceptor tiles on adjacent upslope soils helps to reduce wetness and seepy spots. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition. In addition, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year.

This soil is fairly suited to trees. The equipment limitation, seedling mortality, and the windthrow hazard are the main management concerns. Since this soil is poorly drained, the use of logging or other equipment must be restricted to drier periods or winter, when the ground is frozen. Seedlings should be planted at close intervals. The surviving trees can then be thinned later to achieve the desired stand density. Silvicultural practices that do not leave widely spaced individual trees will reduce the windthrow hazard. Other limitations or hazards that affect planting or harvesting trees are slight.

The land capability classification is IVe.

993D2—Gara-Armstrong clay loams, 9 to 14 percent slopes, moderately eroded. These strongly sloping soils are on narrow, convex ridgetops and nose slopes and short, convex side slopes on uplands. The moderately well drained Gara soil is on the lower part of slopes, and the moderately well drained and somewhat poorly drained Armstrong soil is on the upper part. Individual areas are long and narrow or irregular in shape, and commonly range from 5 to 30 acres or more in size. They are about 60 percent Gara soil and 40 percent Armstrong soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Gara soil is very dark gray, friable clay loam about 8 inches thick. It is mixed with streaks and pockets of dark yellowish brown subsoil material. The subsoil is about 38 inches thick. The upper part is dark yellowish brown, mottled, firm clay loam; the next part is yellowish brown, mottled, very firm clay; and the lower part is grayish brown and yellowish brown, mottled, firm, calcareous clay loam, and has accumulations of lime. The substratum to a depth of about 60 inches is light brownish gray and yellowish brown, mottled, firm, calcareous clay loam, and has accumulations of lime. Stones and pebbles are in the subsoil and substratum. In some places the surface layer is very dark gray, friable loam about 8 inches thick and the subsurface layer is brown or dark grayish brown, friable loam about 4 inches thick. Scattered stones and boulders have come to the surface through the processes of freezing, thawing, and heaving.

Typically, the surface layer of the Armstrong soil is very dark gray, friable clay loam about 7 inches thick. It is mixed with streaks and pockets of brown subsoil material. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is brown, firm clay loam; the next part is strong brown and yellowish brown, very firm clay; and the lower part is yellowish brown, grayish brown, and light brownish gray, firm clay loam. In some places, the surface layer is very dark grayish brown, friable loam about 7 inches thick and the subsurface layer is brown or dark grayish brown, friable loam about 5 inches thick.

Included with this soil in mapping are small areas of the severely eroded Gara and Armstrong soils. The surface layer of these soils is brown clay loam. These areas are scattered throughout the map unit. They have poor tilth, are difficult to manage, and require greater production inputs to maintain higher yields. The included areas make up 5 to 15 percent of this map unit.

Permeability is moderately slow in the Gara soil and slow in the Armstrong soil. Surface runoff is rapid on both soils. Available water capacity is high in the Gara soil and moderate in the Armstrong soil. The Armstrong soil has a seasonal high water table at a depth of 1 to 3 feet and a high shrink-swell potential. The content of organic matter is about 2 to 3 percent in the surface layer of both soils. The subsoil of the Gara soil has a low supply of available phosphorus and a very low supply of available potassium. The subsoil of the Armstrong soil has a very low supply of available phosphorus and potassium. These soils have fair tilth, and tend to puddle if worked when wet and to crust after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Most areas are used for cultivated crops, hay, or pasture. These soils are poorly suited to corn and soybeans. They are moderately well suited to small grains and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a severe hazard. For occasional row crops, a combination of conservation practices helps to control erosion. These practices can be a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour farming, contour stripcropping, grassed waterways, and a cropping rotation that includes grasses and legumes. Conservation practices upslope that increase infiltration and reduce runoff will also help to control erosion on these soils. Adding organic material and deferring tillage when the soils are wet help to maintain or to improve tilth and fertility, to reduce crusting, and to increase the rate of water infiltration. These Gara and Armstrong soils generally need more nitrogen than the uneroded Gara-Armstrong loams, and require greater production inputs to maintain higher yields and to maintain or improve tilth.

The soils in this map unit are best suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay also helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soils in good condition.

Management may be difficult during periods when the Armstrong soil is wet and seepy. Forage species that tolerate wetness will help to maintain productivity. Proper tile drainage placement on adjacent soils above the seep line will also help legume crops for hay as well as grasses for pasture.

In addition, on both soils, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland. When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. In some places terraces or diversions are needed to protect critically seeded areas.

These soils are moderately well suited to trees, and a few small areas remain in native hardwoods. Seedling mortality and the windthrow hazard are the main management concerns. Natural and planted seedlings do not survive well. Seedlings should be planted at close intervals. The surviving trees can then be thinned later to achieve the desired stand density. Silvicultural practices that do not leave widely spaced individual trees will reduce the windthrow hazard. Other limitations or hazards that affect planting or harvesting are slight.

The land capability classification is IVe.

993E2—Gara-Armstrong clay loams, 14 to 18 percent slopes, moderately eroded. These moderately steep soils are on convex valley side slopes on uplands. The moderately well drained Gara soil is on the lower part of the slopes, and the moderately well drained and somewhat poorly drained Armstrong soil is on the upper part. Individual areas are long and narrow or irregular in shape, and commonly range from 5 to 30 acres or more in size. They are about 60 percent Gara soil and about 40 percent Armstrong soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Gara soil is very dark grayish brown, friable clay loam about 7 inches thick. It is mixed with streaks and pockets of dark yellowish brown subsoil material. The subsoil is about 38 inches thick. The upper part is dark yellowish brown, firm clay loam; the next part is yellowish brown, mottled, very firm clay; and the lower part is yellowish brown and light brownish gray, mottled, calcareous clay loam, and has accumulations of lime. The substratum to a depth of about 60 inches is yellowish brown and light brownish gray, mottled, firm, calcareous clay loam, and has accumulations of lime. Stones and pebbles are in the subsoil and substratum. Scattered stones and boulders have come to the surface through the processes of freezing, thawing, and heaving.

Typically, the surface layer of the Armstrong soil is very dark gray, friable clay loam about 7 inches thick. It is mixed with streaks and pockets of brown subsoil material. The subsoil extends to a depth of about 60 inches, and is mottled. The upper part is brown, firm clay loam; the next part is strong brown and yellowish brown, very firm clay; and the lower part is yellowish brown, grayish brown, and light brownish gray, firm clay loam. Stones and pebbles are in the subsoil and substratum.

Included with this soil in mapping are small, severely eroded areas of Gara and Armstrong soils. The surface layer of these soils is brown clay loam. These areas are scattered throughout the map unit. They have poor tilth, are difficult to manage, and require greater production inputs to maintain good yields. The included areas make up 5 to 15 percent of this map unit.

Permeability is moderately slow in the Gara soil and slow in the Armstrong soil. Surface runoff is rapid on both soils. Available water capacity is high in the Gara soil and moderate in the Armstrong soil. The Armstrong soil has a seasonal high water table at a depth of 1 to 3 feet and a high shrink-swell potential. The content of organic matter is about 2 to 3 percent in the surface layer of both soils. The subsoil of the Gara soil has a low supply of available phosphorus and a very low supply of available potassium. The subsoil of the Armstrong soil has a very low supply of available phosphorus and potassium. These soils have fair tilth, and tend to puddle if worked when wet and to crust after hard rains. Germination and seedling development are retarded if crusting occurs prior to seedling emergence.

Most areas are used for hay and pasture, but some areas are cultivated. These soils generally are unsuited to corn, soybeans, and small grains because of the slope and the severe hazard of further erosion. They are moderately well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and the soils in good condition.

Management may be difficult during periods when the Armstrong soil is wet and seepy. Forage species that tolerate wetness will help to maintain productivity. Proper tile drainage placement on adjacent soils above the seep line will also help legume crops for hay as well as grasses for pasture.

In addition, on both soils, fertility maintenance, weed and brush control, and timely applications of lime help to improve the productivity of pasture and hayland.

Figure 14.—Switchgrass on the Gara and Armstrong soils provides excellent habitat for wildlife.

When pasture and hayland are renovated, all cultural and seedbed preparation as well as interseeding practices, if done on the contour, help to control erosion. Interseeding grasses and legumes into the existing sod minimizes the erosion hazard and results in a minimum loss of grazing or hay production during the seeding year. In some places terraces and diversions are needed to protect critically seeded areas.

These soils are moderately well suited to trees, and a few areas remain in native hardwoods. Erosion is a hazard, and the slope is a limitation. Also, seedlings do not survive well on the Armstrong soil, and the windthrow hazard is severe. Planting trees at close intervals and then thinning the surviving trees helps to achieve the desired stand density. Silvicultural practices that do not leave widely spaced individual trees will reduce the windthrow hazard. Laying out logging trails or roads on or nearly on the contour helps to control erosion. Because of the slope, operating logging equipment is somewhat hazardous. Special equipment and caution in its use are needed. Other limitations or hazards that affect planting or harvesting trees are slight.

These soils are moderately well suited to use as habitat for woodland wildlife and are well suited to use as habitat for openland wildlife (fig. 14). Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas help to maintain or improve the habitat.

The land capability classification is VIe.

1715—Nodaway-Lawson silt loams, channeled, 0 to 2 percent slopes. These nearly level, moderately well drained and somewhat poorly drained soils are on the first bottom along the major streams. They are dissected by old stream channels that are sometimes filled with water. They are subject to frequent flooding. Individual areas are long and narrow, and commonly range from 20 to 150 acres or more in size and extend for several miles. They are about 50 percent Nodaway soil and 40 percent Lawson soil. These two soils are in areas so intricately mixed or so small and narrow that mapping them separately is not practical.

Typically, the surface layer of the Nodaway soil is very dark gray and very dark grayish brown, friable silt loam about 9 inches thick. The substratum to a depth of about 60 inches is stratified very dark grayish brown, grayish brown, and very dark gray, mottled, friable silt loam that has thin layers of loam, sandy loam, or silty clay loam. In some places the surface layer is loam, silty clay loam, or sandy loam.

Typically, the surface layer of the Lawson soil is very dark brown, friable silt loam about 9 inches thick. The subsurface layer is friable silt loam about 33 inches thick. It is very dark brown in the upper part and very dark grayish brown and mottled in the lower part. The substratum to a depth of about 60 inches is very dark grayish brown and dark grayish brown, mottled, friable silt loam.

Included with these soils in mapping are small scattered areas of the Colo soils. The Colo soils are poorly drained. They make up about 10 percent of the map unit.

Permeability of both Nodaway and Lawson soils is moderate. Surface runoff is slow on both soils. Available water capacity is very high in both soils. These soils have a seasonal high water table at a depth of 1 to 3 feet. The content of organic matter is about 1 or 2 percent in the surface layer of the Nodaway soil and 4.5 to 6.0 percent in the surface layer of the Lawson soil. Both soils generally have a medium supply of available phosphorus and a very low and low supply of available potassium. These soils have good tilth, but generally a small acreage is tilled.

Most areas are in woodland and pasture. Because of the flooding and the old stream channels that are ponded for long periods, these soils are unsuited to corn, soybeans, and small grains and to grasses and legumes for hay. They are best suited to use as woodland, pasture, and wildlife habitat. If cultivated crops are to be grown, clearing the soils of trees and other vegetation, land shaping, flood control, clearing debris from the active stream channels, and surface drainage are needed.

These soils are suited to pasture. However, overgrazing or grazing during wet periods after flooding causes surface compaction and puddling of these soils. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soils in good condition. In addition, suitable forage selection, fertility maintenance, and timely applications of lime help to improve the productivity of pasture.

These soils are well suited to trees, and many areas remain in native hardwoods. New stands of trees can be easily harvested or planted if species are properly selected and managed.

The land capability classification is Vw.

5030—Pits, limestone quarries. This map unit consists of pits from which limestone has been quarried, mainly for use in road construction and as agricultural lime (fig. 15). The pits are commonly 40 or more feet deep, and are surrounded by piles of spoil material 15 or more feet high. They are irregular in shape, and commonly range from 6 to 20 acres in size.

The spoil surrounding the pits varies in texture, but generally is loamy and contains varying amounts of limestone fragments. It is derived from glacial till, eolian material, or a mixture of the two. Permeability ranges from moderate to slow. Surface runoff ranges from medium to very rapid, depending on the slope. The soil material ranges from medium acid to mildly alkaline.

In some areas the spoil has been leveled and smoothed, but in other areas it is very uneven. Establishing grasses or trees is fairly easy in the leveled areas.

Pits, limestone quarries, and surrounding piles of spoil have good potential for use as habitat for wildlife. Some abandoned pits have steep side slopes and contain water of varying depth. Because of the slope

Figure 15.—Mining in an area of Pits, limestone quarries.

and the variable water depth, these pits could be dangerous as sites for recreation. Detailed investigation is needed to determine the suitability of a site for a specific use.

This map unit does not have a land capability classification.

5040—Orthents, loamy. These nearly level to strongly sloping soils are in borrow areas, cut and fill areas, sanitary landfills, and reclaimed gravel pits. Areas are mostly rectangular, but some are irregular in shape. Areas commonly range from 4 to 25 acres or more in size.

The soil material differs from area to area, but it generally is derived from glacial till and eolian material. Typically, the uppermost 60 inches is yellowish brown and grayish brown clay loam or silty clay loam. In some areas topsoil has been stockpiled and redistributed on the surface layer.

Permeability varies with soil texture and density. Surface runoff ranges from slow to rapid. Available water capacity is high or moderate. Unless the topsoil has been stockpiled and redistributed, the content of organic matter is very low. These soils are slightly acid to moderately alkaline. The supply of available phosphorus and potassium generally is very low.

Some areas are cultivated. Some are used as permanent pasture or support weeds. These soils are poorly suited to cultivated crops. They are better suited to small grains and to grasses and legumes for hay and pasture. Erosion is a severe hazard if the more sloping areas are cultivated. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. Also, other measures that stabilize the soils are needed. Returning crop residue to the soils or regularly adding other organic material improves fertility and tilth.

The use of these soils as permanent pasture is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and these soils in good condition. In addition, suitable forage selection, fertility maintenance, weed control, and timely applications of lime help to improve the productivity of pasture.

Some areas are suitable for use as woodland or habitat for wildlife. Special care is needed in selecting tree species that are suited to the soil conditions at the specific site.

This map unit does not have a land capability classification.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

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

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

About 60,000 acres in the survey area, or nearly 20 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county, but most are in the southern part, mainly in associations 3, 7, and 8, which are described under the heading "General Soil Map Units." About 45,000 acres of this prime farmland is used for crops. The crops grown on this land, mainly corn and soybeans, account for an estimated two-thirds of the county's total agricultural income each year.

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

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

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

Use and Management of the Soils

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

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

Information in this section can be used to plan the use and management of soils for crops and pasture; as 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

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.

In 1985, about 121,480 acres in Clarke County, or 44 percent of the total acreage, was cropland *(4)*. The main crops are corn and soybeans. The major hay crop is alfalfa or alfalfa-grass. The acreage used for row crops has increased in recent years, but the extent of the other land uses has decreased. Many of the field crops suited to the soils and climate in the county are not commonly grown. These include sorghum and milo, used mainly for silage; wheat; barley; various pasture grasses; various native grasses, such as bluestem, switchgrass, and indiangrass; sweet corn; nursery stock; early vegetables; and certain orchard crops.

Productivity can be increased and soil conservation enhanced by fitting land use and soil management practices to the soil properties as accurately as possible to each tract of land in the county. Food production could also be increased by the application of the latest crop production technology to all cropland in the county. The latest information on managing the soils for growing different crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service. This soil survey describes the basic characteristics of each kind of soil; it will greatly aid in the application of the crop production technology.

The main management needs on cropland and pasture in Clarke County are measures that help to control water erosion and to maintain or improve fertility and tilth. The other management concerns on cropland are to drain naturally wet soils and seepy areas and to reduce soil blowing.

Water erosion is the major problem on more than 75 percent of the cropland and pasture in Clarke County. It is a hazard if the slope is more than 2 percent. Loss of the surface layer through erosion reduces the productivity of soils and results in sedimentation in streams. Productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into a plow layer. Loss of the surface layer is especially damaging on soils having a subsoil that is low in fertility, such as Shelby and Gara soils, and on soils having a clay textured subsoil, such as Adair, Armstrong, Bucknell, and Clarinda soils.

A study currently being conducted in Iowa indicates that corn yields may be reduced an average of 15 bushels per acre because of loss of topsoil on these soils. Preparing a good seedbed and tilling are difficult on eroded soils because the original, friable surface layer has been removed or thinned and the subsoil is more strongly structured. This subsoil commonly is hard and cloddy after rains or after it has been tilled when wet. Runoff from eroding soils commonly deposits sediment in streams, drainageways, and road ditches. Control of erosion not only helps to maintain the productivity of soils, but also, by minimizing the pollution of streams, improves the quality of water for municipal use, recreation, and fish and wildlife.

Because of a great variety of soils and landscape features, a variety of erosion control measures is needed in Clarke County. The best measures provide a protective cover of plants or crop residue, reduce the runoff rate, and increase the rate of water infiltration. Examples are cover crops, contour stripcropping, contour farming, terraces, diversions, grassed headlands, grassed waterways, and conservation tillage. Generally, a combination of several measures is most effective.

A cropping system that keeps a plant cover on the surface for extended periods can hold soil losses to an amount that will not reduce the productive capacity of the soils. Soils that are on steep and very steep slopes are not suitable for row crops, and should remain under a protective cover of grasses or trees. On livestock farms, where part of the acreage is hayland or pasture, forage crops of grasses and legumes not only provide nitrogen and improve tilth for the next cropping season but also provide a protective plant cover.

A conservation tillage system that leaves a protective amount of crop residue on the surface after planting is effective in controlling erosion, especially on the more sloping soils. The following are some examples of the major kinds of conservation tillage. No-till is a system in which the seedbed is prepared and the seed is planted in one operation. The surface is disturbed only in the immediate area of the planted seed row. A protective cover of crop residue is left undisturbed on the rest of the surface. Strip-till also is a system in which the seedbed is prepared and the seed is planted in one operation. Tillage is limited to a strip not wider than one-third of the row width. A protective cover of crop residue is left on two-thirds of the surface. Mulch-till is a system in which the soil is loosened throughout the field and as much as 70 percent of the crop residue is incorporated into the soil. Seedbed preparation and planting can be one or several operations.

Terraces and diversions control runoff and erosion by reducing the length of slopes (fig. 16). They are most effective on moderately well drained, gently sloping or moderately sloping soils that have smooth slopes, such as Pershing and Sharpsburg soils. They are less effective in areas where the slopes are irregular or too steep.

Tile-intake terraces help to prevent the accumulation of runoff. If terraces are constructed on soils that formed in loess, such as Arispe, Grundy, Nira, and Sharpsburg soils, incorporation of the more slowly permeable, adjacent soils, such as Adair, Clarinda, and Lamoni soils, should be avoided or minimized. Because of the high content of clay in the more slowly permeable soils, designing and constructing the terraces and revegetating the terrace slope are difficult and seepage can be a problem following construction. If terraces are constructed, the topsoil should be stockpiled and spread over the excavated and built-up areas to ease the restoration of productivity. Diversions commonly are constructed upslope from the Olmitz soils on foot slopes. They help to control runoff from the adjacent uplands.

Contour farming and contour stripcropping effectively control erosion in Clarke County. They are most effective on soils that have smooth, uniform slopes, such as Arispe, Grundy, Pershing, and Sharpsburg soils.

Gully-control structures, grassed waterways, and farm ponds help to control erosion in watercourses (fig. 17). Farm ponds also provide a supply of water for livestock and recreation.

Information about conservation measures that control soil erosion is available at the Clarke County Soil Conservation Service office.

Drainage is a major management concern on about 7

Figure 16.—A tile outlet terrace with a steep back slope helps to control water erosion on Nira silty clay loam, 5 to 9 percent slopes, moderately eroded.

percent of the acreage in Clarke County. Artificial drainage typically is needed in the Colo, Humeston, Vesser, and Zook soils on flood plains and the Edina, Haig, and Winterset soils on uplands.

Artificially draining poorly drained or very poorly drained soils generally increases productivity and expands the choice of crops that can be grown. The drains should be more closely spaced in the slowly permeable soils than in the more rapidly permeable soils. Because of the slow or very slow permeability in the Adair, Clarinda, Lamoni, and other soils that formed in a paleosol on uplands, seepy areas are common within the surrounding soils. Installing lateral interceptor tile drains upslope from the slowly permeable or very slowly permeable soils helps to intercept and drain the excess moisture at the point where loess and glacial till are in contact.

Soil blowing is a minor management concern in Clarke County. Fall plowing on the nearly level Haig and Winterset soils causes a hazard of soil blowing in early spring. If the winds are strong and the soils are dry and bare, soil blowing can damage these soils. A plant cover, surface mulching, windbreaks, and tillage methods that leave about 50 percent crop residue on the surface minimize soil blowing.

Fertility is affected by the supply of available phosphorus and potassium in the subsoil, by reaction, and by the content of organic matter in the surface layer. The fertility level varies widely in the soils of Clarke County. In most of the soils, the supply of

Figure 17.—A farm pond built in an area of Gara and Armstrong soils. The permanent vegetation is effective in controlling erosion.

available phosphorus and potassium is low or very low and reaction is neutral to strongly acid.

On acid soils, applications of ground limestone are needed to promote good plant growth. On all soils, the kinds and amounts of lime and fertilizer needed should be determined by the results of soil tests, the needs of the crop, and the expected level of yields. Soil tests generally provide the most beneficial information. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime that should be applied.

Tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils with good tilth generally have a high content of organic matter, and are granular and porous. In most of the uneroded, upland soils that formed under prairie grasses, such as Grundy and Shelby soils, the content of organic matter in the surface layer is about 3.0 to 4.5 percent. In the eroded, upland soils that formed under prairie grasses, it is less than 1 to 3 percent, depending on the degree of erosion that has taken place. It also is less than 1 to 3 percent in the Gara and Pershing soils, which formed under mixed prairie grasses and deciduous trees. Most of the soils on bottom land have the highest content of organic matter. The content is 4 to 7 percent on the bottom land soils that have a surface layer of silty clay loam. It is lower in the stratified soils that have a surface layer of silt loam, such as Nodaway soils. Regular additions of crop residue, manure, and other organic material improve soil structure and tilth and help to prevent the formation of a surface crust.

On soils that formed in glacial till, such as Adair, Armstrong, Gara, Keswick, Lindley, and Shelby soils, large stones commonly have accumulated on the surface. The stones can hinder fieldwork unless they are removed. Most of the permanent pasture in the county supports bluegrass (fig. 18). Some pastures have been renovated, and support birdsfoot trefoil or crownvetch. Other common suitable species in the pastured areas are bromegrass, reed canarygrass, orchardgrass, switchgrass, big bluestem, indiangrass, alfalfa, red clover, and ladino clover. Most of the bluegrass pastures are not used as cropland because in these areas the soils are too steep for cultivation. Overgrazing or grazing when the soils are wet causes surface compaction, which restricts root development, reduces forage production, and increases runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soils in good condition. In addition, suitable forage selection, fertility maintenance, weed and brush control, and timely application of lime help to improve the productivity of pasture and hayland.

Erosion is a severe hazard if the plant cover is destroyed when the more sloping pastures are renovated. Interseeding the grasses and legumes in the existing sod eliminates the need for destroying the plant cover during seedbed preparation. If cultivated crops are to be grown prior to seeding, a system of conservation tillage that leaves plant residue on the surface, contour farming, and grassed waterways help to control erosion.

Yields Per Acre

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

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations 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. 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

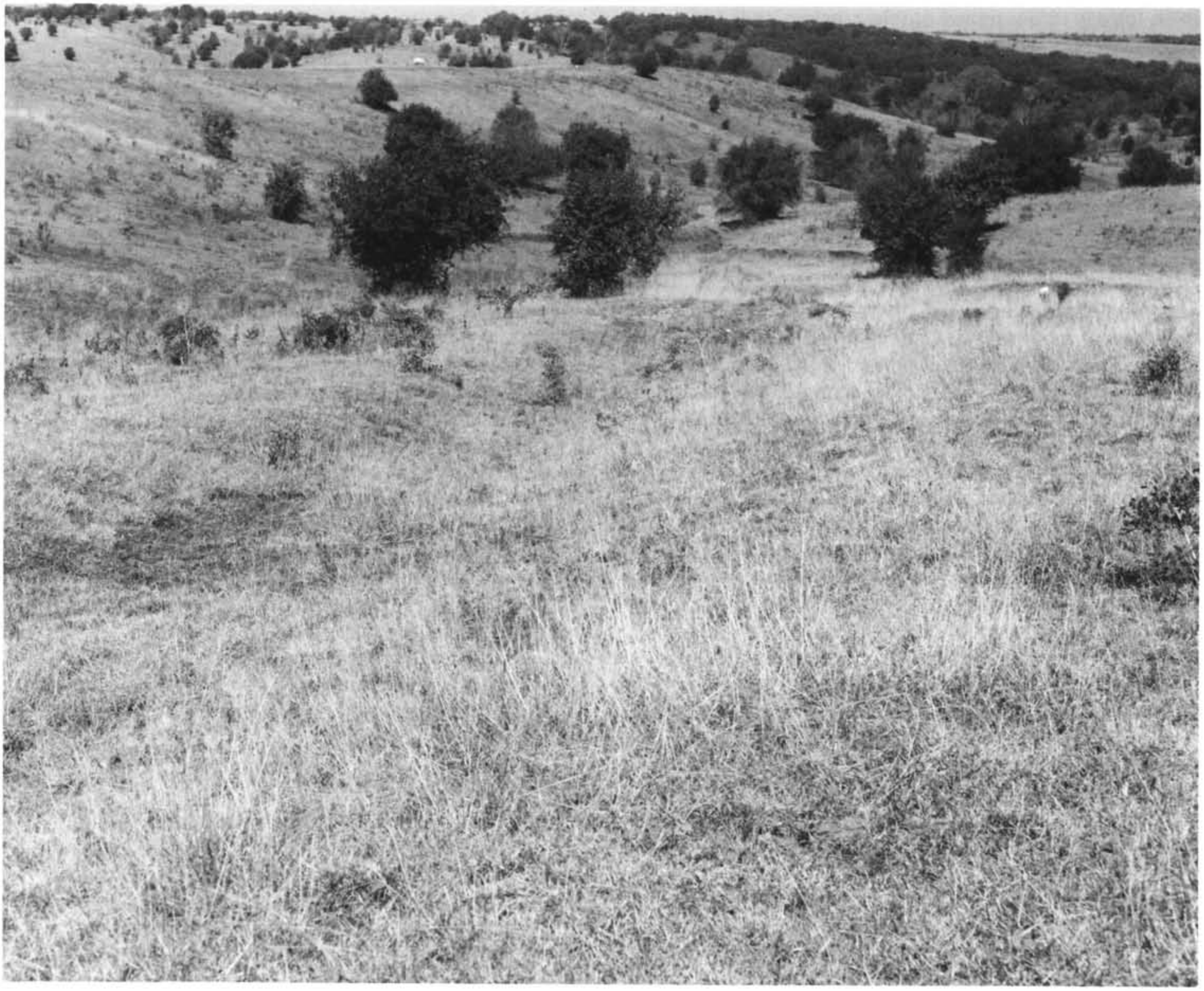

Figure 18.—Pasture on Olmitz-Zook-Colo complex, 0 to 5 percent slopes. The Gara soils on 18 to 25 percent slopes are in the background.

narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

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

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

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

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

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

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

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

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

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

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

Woodland Management and Productivity

The original land survey of Iowa, made during the period 1832-59, indicated that about 55,560 acres, or 20 percent of Clarke County, was woodland when the first settlers arrived. Part of the timber was harvested by the early settlers for construction, firewood, and fenceposts; and part of the woodland was cleared for agricultural uses. The acreage of woodland, according to Forest Service surveys, declined to about 39,000 acres by 1954 and 22,500 acres by 1974. During the last 30 years most of the timber removed was taken from moderately steep and steep, highly erodible soils that were converted from woodland to agricultural uses.

Upland slopes in the county principally support white oak, northern red oak, black oak, bur oak, shagbark hickory, bitternut hickory, white ash, and hard maple. Lowlands and areas along drainageways have eastern cottonwood, soft maple, green ash, basswood, and black walnut. Small American elm and red elm are abundant, but Dutch elm disease has drastically reduced the number of large trees. Most timber on uplands grows on Lindley, Keswick, Weller, Gara, Armstrong, and Pershing soils. Woodland on bottom land is mainly in areas of the Lawson-Zook association, which is described in the section "General Soil Map Units."

Woodland owners have cut the better species for lumber and furniture. The "high-grading" has left the poorer trees and the less desirable species to regenerate the woodland. The result has been poorer quality woodland. Under scientific woodland management, a stand of trees can produce an increased volume of more valuable wood and also yield a consistent amount of good-quality firewood from year to year. Erosion can also be controlled, and wildlife values can be enhanced.

Some areas of woodland in the county are pastured. If livestock graze or rest in timber, their hooves damage tree bases and roots, compact the soil, and damage or destroy young tree regeneration. Also, livestock selectively browse on certain young trees, leaving sparse, poor-quality saplings that grow at a slower rate.

Trees and feed grains are both crops. Compared to feed grains, however, tree crops require a much longer time between planting and harvesting. To produce the best crop, certain basics of management are required. The woodland must be protected from fire and destructive grazing. Then, to enhance wildlife and other benefits, the best potential crop trees should be marked or planted and allowed to grow. The next step is to remove undesirable trees and vines that are competing with the crop trees for moisture, nutrients, and light. Total tree removal over a designated period of time should not exceed total amount of growth. As certain crop trees become mature and ready to harvest, other, younger trees await their growing space.

Soils vary greatly in their suitability for trees, and trees also vary greatly in their ability to tolerate different soils. As an example, green ash will tolerate a wet, poorly drained site as well as a droughty, south-facing slope. Most species, however, cannot tolerate so wide a range in soil conditions. Most species will grow and survive on a narrow to wide range of soils, but will grow at their best rate on a particular site with a particular soil composition. North-facing and east-facing slopes are better suited to trees than are south-facing and west-facing slopes. Generally, the deep, moderately well drained soils that have medium to high fertility are well suited to trees. If the subsoil is slowly permeable, root development and, consequently, total development of trees are reduced.

Landowners can get help from the Soil Conservation District in judging the best use of their land. District Foresters of the Iowa Conservation Commission can lend assistance in woodland management, tree planting, and insect and disease control.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

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

In table 7, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

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

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment or season of use is not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

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

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

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

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

The first species listed under *common trees* for a soil is the indicator species for that soil. It is the dominant

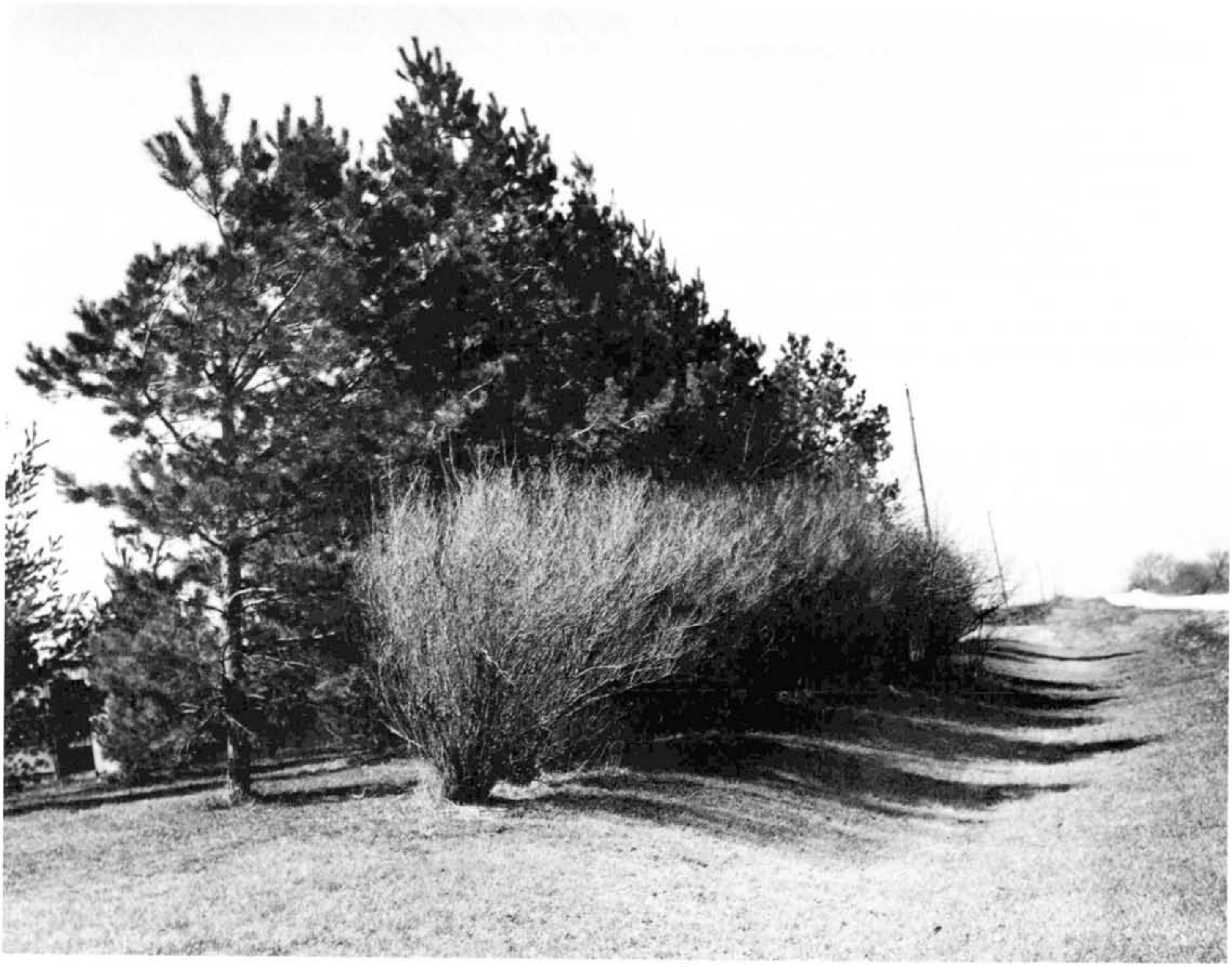

Figure 19.—A windbreak around a farmstead on Grundy silty clay loam, 2 to 5 percent slopes. Windbreaks save energy in homes and shelter livestock and wildlife.

species on the soil and the one that determines the ordination class.

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

Windbreaks and Environmental Plantings

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 (fig. 19).

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, reduce energy requirements, and provide food and cover for wildlife.

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

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

Recreation

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

Clarke County supports many kinds of wildlife. These abundant and varied wildlife resources have a positive effect on the local economy, mainly by providing opportunities for hunting and fishing. Also, songbirds and hawks, owls, snakes, and other predators are beneficial because they control rodents and undesirable insects.

The soils in the county indirectly affect the kind and abundance of wildlife through their effect on vegetation and land use. Topography affects wildlife through its effect on land use. On moderately steep and steep areas, such as most areas of Lindley soils, the undisturbed vegetation is valuable to wildlife. Planning suitable vegetation where needed on the more sloping prairie soils, such as Shelby soils, can improve habitat for the desirable kinds of wildlife. The nearly level Edina, Haig, Macksburg, and Winterset soils generally are cropped intensively. They provide only limited shelter and nesting areas for wildlife, but they provide corn and small grains for feed. Much of the wildlife in the county inhabits areas of the strongly sloping to steep Gara, Lindley, Shelby, Bucknell, Lamoni, Armstrong, Adair, and Keswick soils on uplands. Because these soils are along streams throughout the county, the wildlife is well distributed.

On uplands, raccoon, coyote, skunk, opossum, squirrel, and cottontail generally are abundant. White-tailed deer frequent all areas of Gara-Armstrong-Pershing, Gara-Armstrong-Sharpsburg, Lindley-Keswick-Weller, and Lawson-Zook associations, which are described in the section "General Soil Map Units." Muskrat, mink, and beaver frequent the creeks throughout the county. They probably are more numerous in areas of the Lawson-Zook association.

Quail and pheasant are plentiful throughout the county. Quail are most abundant in the Gara-Armstrong-Pershing and Gara-Armstrong-Sharpsburg associations, and pheasants are most numerous in areas of Shelby-Lamoni-Arispe, Shelby-Lamoni-Sharpsburg, and Macksburg-Nira-Clarinda associations. Wild turkeys are increasing in the county, and the highest number are found in the Lindley-Keswick-Weller association and the wooded part of the Gara-Armstrong-Pershing association. All three species, quail, pheasant, and wild turkey, provide excellent hunting during years of favorable weather and habitat conditions.

Ponds and reservoirs provide good habitat for waterfowl, particularly mallard, teal, and Canada geese, and the larger streams support a good population of wood ducks. Zook and Nodaway soils provide potential sites for dikes and impoundments, which will improve the habitat for waterfowl. Areas of these soils provide food and cover, and are also suitable sites for hunting blinds.

Fish, mainly catfish, bullheads, carp, and various minnows, are fairly plentiful in the major streams. Many privately owned artificial ponds that range from 0.5 to 15 acres in size are well distributed throughout the county. Some well managed ponds provide excellent fishing for bass, bluegill, and catfish. Internal drainage, available water capacity, the texture of the subsoil, and permeability are important factors affecting the selection of sites for stocked farm ponds and the development of habitat for waterfowl. West Lake, East Lake, and Q Pond provide excellent fishing and enhance the habitat for wildlife. West Lake is the municipal and industrial water reservoir for Osceola and nearby rural areas (fig. 20). Areas of the Shelby-Lamoni-Arispe and Gara-Armstrong-Pershing associations adjacent to these bodies of water are suitable for food plantings that improve the habitat for waterfowl and other wildlife.

Although many areas in the county are suitable as wildlife habitat, many more can be improved or developed. Generally, some soils on each farm support good wildlife habitat if they are properly managed. Small, irregularly shaped areas of limited value for other uses can be developed for use as wildlife habitat. Examples are many areas of the strongly sloping to steep Adair, Armstrong, Gara, and Lindley soils. Fencing brushy or wooded areas keeps livestock from destroying the food and cover within. The borders of fields can be planted to grasses and legumes. These areas should not be clipped, especially during nesting season for upland birds.

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

Figure 20.—West Lake supplies water to Osceola and nearby rural areas and enhances habitat for wildlife.

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, and barley.

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

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

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, birch, cherry, maple, apple, hawthorn, dogwood, hickory, blackberry, and elderberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are gray dogwood, autumn-olive, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are 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, cordgrass, rushes, sedges, and reeds.

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

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

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

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include 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, shore birds, 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 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 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, 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, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, 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 calcium carbonate 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, highly organic layers, and soil reaction affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

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

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

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock 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 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, and bedrock.

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 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 or stones, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

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

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

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, 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 or organic matter. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

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; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity. Availability of drainage outlets is not considered in the ratings.

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

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, 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, CL-ML.

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

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

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

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

Physical and Chemical Properties

Table 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 ⅓ bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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.

If a soil is assigned to two hydrologic groups in table 17, 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 and 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, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 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.

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 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 Aquoll *(Aqu*, meaning water, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplaquolls *(Hapl*, meaning minimal horizonation, plus *aquoll*, the suborder of the Mollisols that has an aquic 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 Haplaquolls.

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, montmorillonitic, mesic, sloping Typic Haplaquolls.

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

Soil Series and Their Morphology

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

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual (16)*. 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."

Ackmore Series

The Ackmore series consists of somewhat poorly drained or poorly drained, moderately permeable soils on flood plains and alluvial fans along major streams. These soils formed in recently deposited silty alluvium. Native vegetation was mixed prairie grasses and deciduous trees. Slopes range from 0 to 2 percent.

Typical pedon of Ackmore silt loam, 0 to 2 percent slopes, in cropland; 395 feet north and 1,520 feet east of the southwest corner of sec. 31, T. 71 N., R. 27 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam (23 percent clay), grayish brown (10YR 5/2) dry; weak fine granular structure; friable; common medium and many fine and very fine roots; neutral; abrupt smooth boundary.

C1—8 to 19 inches; stratified dark grayish brown (10YR 4/2), very dark grayish brown (10YR 3/2), and grayish brown (10YR 5/2) silt loam (20 percent clay); common fine distinct yellowish brown (10YR 5/4) mottles; massive; friable; thin bands of light gray (10YR 7/2) dry silt and very fine sand strata; common medium and many fine and very fine roots; neutral; abrupt smooth boundary.

C2—19 to 25 inches; stratified very dark grayish brown (10YR 3/2), grayish brown (10YR 5/2), dark grayish brown (10YR 4/2), and very dark gray (10YR 3/1) silt loam (25 percent clay); massive; friable; thin bands of light gray (10YR 7/2) dry silt and very fine sand strata; few medium and many fine and very fine roots; neutral; abrupt smooth boundary.

2Ab1—25 to 35 inches; black (10YR 2/1 and N 2/0) silty clay loam (30 percent clay); moderate fine and very fine granular structure; friable; many fine and very fine roots; neutral; clear smooth boundary.

2Ab2—35 to 48 inches; black (N 2/0) silty clay loam (35 percent clay); moderate fine and very fine granular structure; friable; common fine and very fine roots; slightly acid; gradual smooth boundary.

2Ab3—48 to 60 inches; very dark gray (10YR 3/1) silty clay loam (34 percent clay); common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; friable; few fine and very fine roots; few fine dark concretions (iron and manganese oxides); neutral.

The A and C horizons range from 20 to 36 inches in thickness.

The A horizon has chroma of 1 or 2. The strata in the C horizon have value of 3 to 5 and chroma of 1 or 2. The 2Ab horizon typically is silty clay loam, but ranges to silt loam. It has a clay content of 26 to 38 percent. In some pedons chroma of 1 or 2 are below a depth of 48 inches.

Adair Series

The Adair series consists of moderately well drained and somewhat poorly drained, slowly permeable soils on short, convex side slopes and nose slopes and on convex summits of narrow interfluves on uplands. These soils formed in a thin mantle of loess and pedisediments and in the underlying paleosol that weathered from glacial till. Native vegetation was tall prairie grasses. Slopes range from 5 to 14 percent.

Typical pedon of Adair loam, 5 to 9 percent slopes, in pasture; 1,915 feet north and 1,560 feet east of the southwest corner of sec. 16, T. 72 N., R. 24 W.

Ap—0 to 8 inches; black (10YR 2/1) loam (27 percent clay), dark gray (10YR 4/1) dry; moderate fine granular structure; friable; common medium and many fine roots; slightly acid; clear smooth boundary.

A—8 to 11 inches; very dark grayish brown (10YR 3/2) clay loam (32 percent clay), grayish brown (10YR 5/2) dry; very dark gray (10YR 3/1) faces of peds; weak fine and medium subangular blocky structure; friable; few medium and many fine and very fine roots; brown (7.5YR 4/4) worm casts; strongly acid; clear smooth boundary.

2Bt1—11 to 14 inches; brown (7.5YR 4/4) clay loam (39 percent clay); common fine prominent yellowish red (5YR 4/6) mottles; moderate fine and medium subangular blocky structure; firm; common distinct brown (7.5YR 5/2) clay films on faces of peds; many fine and very fine roots; few fine dark concretions (iron and manganese oxides); about 4 percent pebbles; strongly acid; clear smooth boundary.

2Bt2—14 to 23 inches; reddish brown (5YR 4/4) and red (2.5YR 4/8) clay (54 percent clay); common fine prominent strong brown (7.5YR 5/8) mottles; moderate fine and medium subangular blocky structure; very firm; many distinct brown (7.5YR 5/2) clay films on faces of peds; many fine and very fine roots; few fine dark concretions (iron and manganese oxides); about 4 percent pebbles; medium acid; gradual smooth boundary.

2Bt3—23 to 29 inches; strong brown (7.5YR 5/6) clay (51 percent clay); common fine distinct yellowish red (5YR 4/6) and grayish brown (10YR 5/2) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; very firm; common distinct brown (7.5YR 4/2) clay films on faces of peds; common fine and very fine roots; few fine dark concretions (iron and manganese oxides); about 4 percent pebbles; medium acid; gradual smooth boundary.

2Bt4—29 to 42 inches; yellowish brown (10YR 5/6) and light brownish gray (2.5Y 6/2) clay (43 percent clay); many fine distinct brownish yellow (10YR 6/8) and common fine distinct strong brown (7.5YR 4/6) mottles; moderate medium prismatic structure; very firm; common distinct grayish brown (10YR 5/2) clay films on faces of prisms; few fine and very fine roots; few fine dark concretions (iron and manganese oxides); about 5 percent pebbles; medium acid; gradual smooth boundary.

2BC—42 to 60 inches; yellowish brown (10YR 5/6) and light brownish gray (2.5Y 6/2) clay loam (36 percent clay); common fine and medium distinct strong brown (7.5YR 4/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; few fine and very fine roots; few fine dark concretions (iron and manganese oxides); about 4 percent pebbles; neutral.

Solum thickness and the depth to free carbonates range from 48 to more than 60 inches. In uneroded soils the mollic epipedon is 10 to 15 inches thick.

The A or Ap horizon has value of 2 or 3 and chroma of 1 or 2. It typically is loam, but ranges to clay loam and silt loam. Some pedons have an AB or BA horizon as much as 5 inches thick. The upper part of the 2Bt horizon has hue of 5YR to 10YR, value of 3 to 5, and chroma of 3 to 6. It is clay loam or clay. The lower part of the 2Bt and 2BC horizons typically have hue of 10YR, but range to hue of 7.5YR to 5Y.

The Adair soils in map units 93D2, 93D3, 192C2, 192D2, and 192D3 are taxadjuncts to the Adair series because these soils do not have a mollic epipedon, which is definitive for the Adair series.

Arispe Series

The Arispe series consists of somewhat poorly drained, moderately slowly permeable soils on short, convex side slopes in the coves of drainageways and on low, narrow interfluves on uplands. These soils formed in loess. Native vegetation was tall prairie grasses. Slopes range from 5 to 9 percent.

Typical pedon of Arispe silty clay loam, 5 to 9 percent slopes, in pasture; 785 feet south and 1,155 feet west of the northeast corner of sec. 29, T. 71 N., R. 26 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam (33 percent clay), dark gray (10YR 4/1) dry; moderate fine and very fine granular structure; friable; many fine and very fine and few medium roots; slightly acid; clear smooth boundary.

AB—9 to 13 inches; very dark gray (10YR 3/1) silty clay loam (37 percent clay), dark grayish brown (10YR 4/2) dry; dark grayish brown (10YR 4/2) coatings on faces of peds; weak fine and very fine subangular blocky structure parting to moderate fine granular; firm; many fine and very fine and few medium roots; medium acid; clear smooth boundary.

Bt1—13 to 16 inches; dark grayish brown (2.5Y 4/2) silty clay loam (39 percent clay); many very dark gray (10YR 3/1) organic coatings on faces of peds; common fine prominent yellowish brown (10YR 5/4) mottles; moderate fine and very fine subangular blocky structure; firm; many distinct dark grayish brown (10YR 4/2) clay films on faces of peds; many fine and very fine and few medium roots; few fine dark concretions (iron and manganese oxides); medium acid; clear smooth boundary.

Bt2—16 to 22 inches; dark grayish brown (2.5Y 4/2) and grayish brown (2.5Y 5/2) silty clay (41 percent clay); few very dark gray (10YR 3/1) organic coatings on faces of peds and in root channels; common fine prominent yellowish brown (10YR 5/6) and common fine prominent strong brown (7.5YR 4/6) mottles; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; firm; many distinct dark grayish brown (10YR 4/2) clay films on faces of peds; many fine and very fine roots; common fine dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Bt3—22 to 32 inches; grayish brown (2.5Y 5/2) silty clay loam (37 percent clay); few very dark gray (10YR 3/1) organic coatings in root channels; common fine and medium prominent yellowish brown (10YR 5/6) and few fine prominent strong brown (7.5YR 4/6) and dark reddish brown (5YR 3/4) mottles; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; firm; many distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; common fine and very fine roots; common fine dark concretions and stains (iron and manganese oxides); slightly acid; gradual smooth boundary.

Bt4—32 to 42 inches; grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) silty clay loam (35 percent clay); common fine and medium prominent strong brown (7.5YR 4/6) and yellowish red (5YR 4/6) and common fine prominent yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; firm; common distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; common fine and very fine roots; common fine and medium dark concretions and stains along with a 3-inch zone of dark concretions and stains (iron and manganese oxides); slightly acid; gradual smooth boundary.

BC—42 to 53 inches; light brownish gray (2.5Y 6/2) silty clay loam (33 percent clay); common fine and medium prominent yellowish brown (10YR 5/6) and common fine prominent strong brown (7.5YR 4/6) and yellowish red (5YR 4/6) mottles; weak medium prismatic structure; friable; common faint grayish brown (2.5Y 5/2) clay films on faces of prisms and in root channels; few fine and very fine roots; common fine dark concretions and stains (iron and manganese oxides); slightly acid; gradual smooth boundary.

C—53 to 60 inches; light olive gray (5Y 6/2) silty clay loam (32 percent clay); common fine and medium prominent yellowish brown (10YR 5/6) and common fine prominent strong brown (7.5YR 4/6) mottles; massive with some cleavage planes; friable; few fine and very fine roots; common fine dark concretions and stains (iron and manganese oxides); slightly acid.

The solum ranges from 36 to 60 or more inches in thickness. The solum is leached of free carbonates.

The Ap or A horizon typically has value of 2 or 3 and chroma of 1 or 2. The mollic epipedon is 10 to 16 inches thick, and includes the Ap or A horizon and the AB or BA horizon. The Ap or A horizon is silty clay loam that has a clay content of 30 to 35 percent. The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 or 3. The clay is at a maximum at a depth of about 10 to 22 inches, and typically ranges from 35 to 42 percent clay, by volume. The BC horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 or 2.

The Arispe soil in map unit 23C2 is a taxadjunct to the Arispe series because this soil does not have a mollic epipedon, which is definitive for the Arispe series.

Armstrong Series

The Armstrong series consists of moderately well drained and somewhat poorly drained, slowly permeable soils on convex side slopes, summits of narrow interfluves, and nose slopes on uplands. These soils formed in a thin mantle of loess and pedisediments and in the underlying paleosol that weathered from glacial till. Native vegetation was mixed prairie grasses and deciduous trees. Slopes range from 5 to 18 percent.

Typical pedon of Armstrong loam, 9 to 14 percent slopes, in pasture; 535 feet north and 785 feet west of the southeast corner of sec. 20, T. 72 N., R. 27 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate fine and medium granular structure; friable; common medium and many fine roots; slightly acid; abrupt smooth boundary.

EB—7 to 12 inches; dark grayish brown (10YR 4/2) and yellowish brown (10YR 5/4) loam; few very dark grayish brown (10YR 3/2) organic coatings on faces of peds; common fine distinct strong brown (7.5YR 5/6) mottles; weak fine and medium subangular blocky structure; friable; common pale brown (10YR 6/3) dry silt coatings and very fine uncoated sand grains on faces of peds; very dark gray (10YR 3/1) organic coatings in root channels; many fine and very fine and few medium roots; medium acid; clear smooth boundary.

2Bt1—12 to 16 inches; brown (7.5YR 4/4 and 5/2) clay (43 percent clay); common fine and medium prominent yellowish red (5YR 4/6) and few fine prominent red (2.5YR 4/6) mottles; moderate fine and medium subangular and angular blocky structure; very firm; many distinct brown (7.5YR 4/2) clay films on faces of peds; few light brownish gray (10YR 6/2) dry silt coatings and very fine uncoated sand grains on faces of peds; common fine and very fine and few medium roots; few fine dark concretions (iron and manganese oxides); a pebble band at the contact of the overlying horizon; about 3 percent pebbles; strongly acid; clear smooth boundary.

2Bt2—16 to 20 inches; brown (7.5YR 4/4 and 5/2) clay (50 percent clay); common fine and medium prominent red (2.5YR 4/6 and 10R 4/8) mottles; moderate fine and medium subangular blocky structure; very firm; many distinct brown (7.5YR 4/2) clay films on faces of peds; few fine and very fine roots; few fine dark concretions (iron and manganese oxides); about 4 percent pebbles; strongly acid; gradual smooth boundary.

2Bt3—20 to 24 inches; brown (7.5YR 4/4) clay (55 percent clay); many fine and medium distinct strong brown (7.5YR 5/6) and common fine prominent red (2.5YR 4/6) mottles; moderate fine and medium prismatic structure parting to moderate fine and medium subangular blocky; very firm; many distinct brown (7.5YR 4/2) clay films on faces of peds; few fine and very fine roots; common fine dark concretions and stains (iron and manganese oxides); about 5 percent pebbles; strongly acid; gradual smooth boundary.

2Bt4—24 to 31 inches; strong brown (7.5YR 5/6) clay (51 percent clay); common fine prominent red (2.5YR 4/6) and common fine distinct grayish brown (10YR 5/2) and strong brown (7.5YR 5/8) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; very firm; many distinct brown (7.5YR 4/2) clay films on faces of peds; few fine and very fine roots; common fine dark concretions and stains (iron and manganese oxides); about 4 percent pebbles; slightly acid; gradual smooth boundary.

2Bt5—31 to 40 inches; yellowish brown (10YR 5/6) clay loam (36 percent clay); common fine and medium distinct grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) mottles; moderate fine and medium prismatic structure; firm; common distinct brown (7.5YR 4/4) clay films on faces of prisms; few fine and very fine roots; common fine and medium dark concretions and stains (iron and manganese oxides); about 3 percent pebbles; slightly acid; gradual smooth boundary.

2Bt6—40 to 51 inches; yellowish brown (10YR 5/6) clay loam (34 percent clay); common fine distinct light gray (10YR 6/1) and common fine and medium prominent strong brown (7.5YR 5/8) mottles; moderate fine and medium prismatic structure; firm; common distinct brown (10YR 4/3) clay films on faces of prisms; few fine and very fine roots; common fine and medium dark concretions and stains (iron and manganese oxides); about 5 percent pebbles; neutral; gradual smooth boundary.

2BC—51 to 60 inches; yellowish brown (10YR 5/6) clay loam (33 percent clay); common fine prominent yellowish red (5YR 4/6) and common fine distinct light brownish gray (2.5Y 6/2) mottles; weak fine and medium prismatic structure; firm; common distinct brown (10YR 4/3) clay films on faces of prisms; few fine and very fine roots; common fine and medium dark concretions (iron and manganese oxides); common accumulations and nodules of carbonates; about 5 percent pebbles; strongly effervescent; mildly alkaline.

The solum thickness and the depth to free carbonates range from 42 to more than 60 inches.

The A or Ap horizon has chroma of 1 or 2. It dominantly is loam, but includes clay loam or silt loam. Some pedons have an E horizon that has value of 4 or 5 and chroma of 2 or 3. It is loam or silt loam. The upper part of the 2Bt horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 2 to 6. It is clay or clay loam. The lower part of the 2Bt horizon and the 2BC horizon have hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 6.

The Armstrong soil in map unit 792D3 is a taxadjunct to the Armstrong series because this soil does not have a dark colored surface layer, which is definitive for the Armstrong series.

Bucknell Series

The Bucknell series consists of somewhat poorly drained, slowly permeable or very slowly permeable soils on convex summits of narrow interfluves and on convex side slopes on uplands. These soils formed in a thin mantle of pedisediments or loess and in the underlying, partly truncated, clayey paleosol that weathered from glacial till. Native vegetation was mixed prairie grasses and deciduous trees. Slopes range from 5 to 14 percent.

Typical pedon of Bucknell silty clay loam, 9 to 14 percent slopes, moderately eroded, in cropland; 1,240 feet south and 990 feet east of the northwest corner of sec. 24, T. 71 N., R. 25 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silty clay loam (35 percent clay), grayish brown (10YR 5/2) dry; mixed with streaks and pockets of dark grayish brown (10YR 4/2) subsoil material; moderate fine and very fine granular structure; friable; common medium and many fine and very fine roots; slightly acid; clear smooth boundary.

Bt1—7 to 10 inches; dark grayish brown (10YR 4/2) silty clay loam (38 percent clay); common very dark grayish brown (10YR 3/2) organic coatings on faces of peds; common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine and very fine subangular blocky structure; firm; common distinct brown (10YR 4/3) clay films on faces of peds; common light gray (10YR 7/2) dry silt coatings on faces of peds; common medium and many fine and very fine roots; few fine dark concretions (iron and manganese oxides); strongly acid; clear smooth boundary.

2Bt2—10 to 14 inches; brown (10YR 5/3) clay (44 percent clay); common fine distinct strong brown (7.5YR 4/6) and many fine distinct yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) mottles; moderate fine and very fine subangular blocky structure; very firm; many distinct dark grayish brown (10YR 4/2) clay films on faces of peds; few medium and many fine and very fine roots; common fine dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

2Bt3—14 to 24 inches; grayish brown (2.5Y 5/2) clay (47 percent clay); many fine distinct yellowish brown (10YR 5/6) and common fine prominent strong brown (7.5YR 4/6) mottles; moderate fine and medium subangular blocky structure; very firm; many prominent gray (10YR 5/1) clay films on faces of peds; few medium and many fine and very fine roots; common fine dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

2Bt4—24 to 28 inches; light gray (10YR 6/1) and yellowish brown (10YR 5/6) clay (40 percent clay); common fine prominent strong brown (7.5YR 4/6) mottles; moderate medium and fine prismatic structure parting to moderate medium subangular blocky; very firm; common prominent gray (10YR 5/1) clay films on faces of peds; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

2Bt5—28 to 46 inches; yellowish brown (10YR 5/6) and light olive gray (5Y 6/2) clay loam (33 percent clay); common fine and medium distinct strong brown (7.5YR 4/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; common distinct light gray (10YR 6/1) clay films on faces of peds; few fine and very fine roots; common fine and medium dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

BC—46 to 60 inches; yellowish brown (10YR 5/4 and 5/6) and light olive gray (5Y 6/2) clay loam (30 percent clay); common fine distinct brown (7.5YR 4/4) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; few fine and very fine roots; many fine and medium dark concretions and stains (iron and manganese oxides); neutral.

The solum ranges from 48 to more than 60 inches in thickness.

The Ap horizon has chroma of 1 or 2. It typically is silty clay loam, but the range includes loam and clay loam. Some pedons have an E horizon that has value of 4 or 5 and chroma of 2 or 3. It is silt loam or loam. The Bt horizon generally is mottled and has hue of 10YR, 2.5Y, or 5Y and chroma of 1 to 8. The maximum content of clay is about 50 percent.

Caleb Series

The Caleb series consists of moderately well drained, moderately permeable soils on convex ridgetops and side slopes of high stream terraces. These soils formed in alluvial sediments derived from glaciers. Native vegetation was mixed prairie grasses and deciduous trees. Slopes range from 9 to 18 percent.

Typical pedon of Caleb loam, in an area of Caleb-Mystic complex, 14 to 18 percent slopes, moderately eroded, in pasture; 1,450 feet north and 1,320 feet west of the southeast corner of sec. 20, T. 72 N., R. 25 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; mixed with streaks and pockets of brown (10YR 4/3) subsoil material; moderate fine and very fine granular structure; friable; few medium and many fine and very fine roots; slightly acid; clear smooth boundary.

Bt1—7 to 11 inches; brown (10YR 4/3) clay loam; common very dark grayish brown (10YR 3/2) organic coatings on faces of peds; common fine distinct strong brown (7.5YR 4/6) mottles; moderate fine and very fine subangular blocky structure; friable; many distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; few medium and many fine and very fine roots; medium acid; clear smooth boundary.

Bt2—11 to 15 inches; yellowish brown (10YR 5/4) clay loam; common fine distinct strong brown (7.5YR 4/6) mottles; moderate fine and very fine subangular blocky structure; friable; many distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; few medium and many fine and very fine roots; strongly acid; clear smooth boundary.

Bt3—15 to 20 inches; yellowish brown (10YR 5/6) clay loam; common fine distinct strong brown (7.5YR 4/6) and grayish brown (10YR 5/2) mottles; moderate fine and medium subangular blocky structure; firm; many distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; common fine and very fine roots; strongly acid; gradual smooth boundary.

Bt4—20 to 27 inches; yellowish brown (10YR 5/6) clay loam; common fine and medium distinct grayish brown (10YR 5/2) and strong brown (7.5YR 5/8) mottles; moderate medium prismatic structure parting to moderate medium and fine subangular blocky; firm; common distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; common fine and very fine roots; few fine dark concretions (iron and manganese oxides); very strongly acid; gradual smooth boundary.

Bt5—27 to 37 inches; yellowish brown (10YR 5/6) sandy clay loam; many fine distinct strong brown (7.5YR 4/6) and common fine distinct grayish brown (10YR 5/2) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; 2-inch-thick stratum of coarse sand and very fine gravel between depths of 32 to 34 inches; common distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; common light gray (10YR 7/2) dry silt and very fine sand coatings on faces of prisms; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

BC—37 to 46 inches; yellowish brown (10YR 5/4) clay loam; common fine and medium distinct grayish brown (10YR 5/2) and many fine distinct brown (7.5YR 4/4) mottles; weak medium prismatic structure; friable; 3-inch-thick stratum of coarse sand and very fine gravel between depths of 40 to 43 inches; common light gray (10YR 7/2) dry silt and very fine sand coatings on faces of prisms; few fine and very fine roots; common fine dark concretions (iron and manganese oxides); strongly acid; clear smooth boundary.

C—46 to 60 inches; yellowish brown (10YR 5/4) loam; common fine and medium distinct grayish brown (10YR 5/2) and many fine distinct yellowish brown (10YR 5/6) mottles; massive with vertical cleavage planes; friable; common white (10YR 8/2) dry silt and very fine sand coatings on faces of peds; few fine and very fine roots; many fine dark concretions (iron and manganese oxides); medium acid.

The solum ranges from 42 to more than 60 inches in thickness. Free carbonates are absent to below a depth of 60 inches. The A or Ap horizon has chroma of 1 or 2. It dominantly is loam, but includes silt loam high in very fine sand and includes clay loam. The Bt horizon is dominantly clay loam that has a clay maximum ranging from 30 to 35 percent. The upper part of the Bt horizon is clay loam, loam, or sandy clay loam. In some pedons thin strata of sandy loam or loamy sand are below a depth of 30 inches.

Cantril Series

The Cantril series consists of somewhat poorly drained, moderately permeable soils on the upland foot slopes and extended alluvial fans. These soils formed in loamy local alluvium and colluvium derived from glacial till and loess. Native vegetation was mixed prairie grasses and deciduous trees. Slopes range from 5 to 9 percent.

Typical pedon of Cantril loam, 5 to 9 percent slopes, in cropland; 1,980 feet south and 1,120 feet west of the northeast corner of sec. 12, T. 71 N., R. 24 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) loam, dark gray (10YR 4/1) dry; moderate fine and very fine granular structure; friable; few medium and coarse and many fine and very fine roots; neutral; abrupt smooth boundary.

E—7 to 10 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; common very dark grayish brown (10YR 3/2) organic coatings on faces of peds; faces of some peds brown (10YR 5/3); common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium platy structure parting to weak medium subangular blocky; friable; common light gray (10YR 7/2) dry silt and very fine sand coatings on faces of peds; few medium and coarse and many fine and very fine roots; medium acid; clear smooth boundary.

BE—10 to 15 inches; grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) clay loam; common fine distinct yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) and few fine prominent strong brown (7.5YR 4/6) mottles; moderate fine and medium subangular blocky structure; friable; common faint brown (10YR 4/3) clay films on faces of peds; many light gray (10YR 7/2) dry silt and very fine sand coatings on faces of peds; few fine dark concretions (iron and manganese oxides); medium acid; clear smooth boundary.

Bt1—15 to 19 inches; grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) clay loam; common fine prominent strong brown (7.5YR 4/6) mottles; moderate fine and medium subangular blocky structure; friable; many distinct dark grayish brown (10YR 4/2) clay films on faces of peds; many light gray (10YR 7/2) dry silt and very fine sand coatings on faces of peds; few medium and many fine and very fine roots; common fine dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

Bt2—19 to 26 inches; dark grayish brown (10YR 4/2) clay loam; common fine distinct yellowish brown (10YR 5/6) and strong brown (7.5YR 4/6) mottles; moderate fine prismatic structure parting to moderate fine and medium subangular blocky; firm; many distinct dark gray (10YR 4/1) clay films on faces of peds; few medium and many fine and very fine roots; common fine dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

Bt3—26 to 37 inches; dark grayish brown (2.5Y 4/2) clay loam; common fine distinct yellowish brown (10YR 5/6) and common fine prominent strong brown (7.5YR 4/6) mottles; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; firm; many distinct dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) clay films on faces of peds; very dark gray (10YR 3/1) organic coatings in root channels and pores; few medium and many fine and very fine roots; common fine dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

Bt4—37 to 48 inches; dark grayish brown (2.5Y 4/2) clay loam; common fine prominent strong brown (7.5YR 4/6) and common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; many distinct dark gray (10YR 4/1) clay films on faces of peds; few medium and many fine and very fine roots; common fine dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

Bt5—48 to 60 inches; dark grayish brown (2.5Y 4/2) clay loam; common fine and medium prominent strong brown (7.5YR 4/6) and yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; many distinct very dark gray (10YR 3/1) and dark grayish brown (10YR 4/2) clay films on faces of peds; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); medium acid.

The solum ranges from 48 to more than 60 inches in thickness.

The Ap or A horizon has chroma of 1 or 2. It is loam or silt loam. The E horizon has value of 4 or 5. It is loam or silt loam that is high in sand. The clay content of the Bt horizon is 28 to 35 percent, but in some pedons thin layers are slightly higher in clay.

Clarinda Series

The Clarinda series consists of poorly drained, very slowly permeable soils on short, convex side slopes and in coves at the heads of drainageways on uplands. These soils formed in a thin mantle of loess and in the underlying, exhumed, gray, clayey paleosol that weathered from glacial till. Native vegetation was tall prairie grasses. Slopes range from 5 to 14 percent.

Typical pedon of Clarinda silty clay loam, 5 to 9 percent slopes, in cropland; 860 feet north and 2,045 feet west of the southeast corner of sec. 18, T. 72 N., R. 26 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam (38 percent clay), dark gray (10YR 4/1) dry; moderate fine and very fine granular structure; friable; few medium sand grains; common medium and many fine roots; slightly acid; clear smooth boundary.

AB—9 to 12 inches; very dark gray (10YR 3/1) silty clay (44 percent clay), dark gray (10YR 4/1) dry; black (10YR 2/1) organic coatings on faces of peds; weak fine subangular blocky structure parting to moderate fine granular; very firm; common medium uncoated sand grains; many fine and very fine roots; strongly acid; clear smooth boundary.

2Btg1—12 to 17 inches; dark gray (10YR 4/1) silty clay (51 percent clay); common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine and very fine subangular blocky structure; very firm; many prominent very dark gray (10YR 3/1) clay films on faces of peds; many uncoated sand grains; few coarse and many fine and very fine roots; strongly acid; gradual smooth boundary.

2Btg2—17 to 24 inches; dark gray (5Y 4/1) silty clay (54 percent clay); common fine and medium prominent light olive brown (2.5Y 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; very firm; many distinct dark gray (10YR 4/1) clay films on faces of peds; very dark gray (10YR 3/1) organic coatings in root channels; many coarse uncoated sand grains; few medium and many fine and very fine roots; medium acid; gradual smooth boundary.

2Btg3—24 to 42 inches; gray (5Y 5/1) clay (43 percent clay); common fine and medium prominent light olive brown (2.5Y 5/6) and yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium and coarse subangular blocky; very firm; common distinct gray (10YR 5/1) clay films on faces of peds; dark gray (10YR 4/1) coatings in root channels; many coarse uncoated sand grains; few medium and many fine and very fine roots; few fine dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

2Btg4—42 to 51 inches; gray (5Y 5/1) clay (42 percent clay); common medium prominent yellowish brown (10YR 5/6) and common medium distinct light olive brown (2.5Y 5/6) mottles; moderate medium prismatic structure; very firm; common distinct gray (10YR 5/1) clay films on faces of prisms; many coarse uncoated sand grains; few fine and very fine roots; few fine dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

2Btg5—51 to 60 inches; gray (5Y 5/1) clay (44 percent clay); common fine and medium prominent yellowish brown (10YR 5/6) mottles; weak medium prismatic structure; very firm; common distinct gray (10YR 5/1) clay films on faces of prisms; many coarse uncoated sand grains; few fine and very fine roots; few fine dark concretions (iron and manganese oxides); slightly acid.

The solum is more than 60 inches thick. In uneroded soils the mollic epipedon ranges from 10 to 18 inches in thickness.

The A horizon has value of 2 or 3. Unless eroded, it formed in loess or silty sediments ranging from 10 to 18 inches in thickness.

The Clarinda soils in map units 222C2, 222C3, and 222D2 are taxadjuncts to the Clarinda series because these soils do not have a mollic epipedon, which is definitive for the Clarinda series.

Clearfield Series

The Clearfield series consists of poorly drained soils in coves at the heads of drainageways on uplands. These soils formed in loess and in the underlying gray, clayey paleosol. Native vegetation was tall prairie grasses tolerant of wetness. These soils are moderately slowly permeable in the upper part of the profile and very slowly permeable in the lower part. Slopes range from 5 to 9 percent.

Typical pedon of Clearfield silty clay loam, 5 to 9 percent slopes, in cropland; 2,310 feet north and 1,980 feet east of the southwest corner of sec. 15, T. 73 N., R. 26 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine and very fine granular structure; friable; common medium and fine roots; neutral; clear smooth boundary.

A—7 to 12 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; common fine prominent strong brown (7.5YR 4/6) mottles; weak fine subangular blocky structure parting to moderate fine and very fine granular; friable; common medium and fine roots; few fine dark concretions (iron and manganese oxides); neutral; clear smooth boundary.

Btg1—12 to 16 inches; dark gray (10YR 4/1) silty clay loam; common fine distinct dark grayish brown (2.5Y 4/2), yellowish brown (10YR 5/6), and prominent strong brown (7.5YR 4/6) mottles; moderate fine and very fine subangular blocky structure; firm; common distinct very dark gray (10YR 3/1) clay films on faces of peds; few medium and many fine and very fine roots; common fine dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

Btg2—16 to 22 inches; dark grayish brown (2.5Y 4/2) silty clay loam; very dark gray (10YR 3/1) faces of peds and in root channels; many fine prominent yellowish brown (10YR 5/6) and common fine prominent strong brown (7.5YR 4/6) mottles; moderate fine prismatic structure parting to moderate fine and medium subangular blocky; firm; many distinct dark gray (10YR 4/1) clay films on faces of peds; few medium and many fine and very fine roots; common fine dark concretions (iron and manganese oxides); slightly acid; gradual wavy boundary.

Btg3—22 to 30 inches; grayish brown (2.5Y 5/2) silty clay loam; very dark gray (10YR 3/1) faces of peds and in root channels; many fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 4/6) mottles; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; firm; many distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

Btg4—30 to 37 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 4/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; friable; common fine distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

BCg—37 to 44 inches; light brownish gray (2.5Y 6/2) silty clay loam; common fine prominent strong brown (7.5YR 4/6) and yellowish brown (10YR 5/6) mottles; weak medium prismatic structure; friable; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

Cg—44 to 50 inches; light olive gray (5Y 6/2) silty clay loam; common fine prominent yellowish brown (10YR 5/6) mottles; massive; friable; few fine roots; few fine dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

2Btgb—50 to 60 inches; gray (10YR 5/1) silty clay; common fine distinct yellowish brown (10YR 5/6) and common fine prominent strong brown (7.5YR 4/6) and grayish brown (2.5Y 5/2) mottles; moderate fine and medium subangular blocky structure; very firm; common distinct dark gray (10YR 4/1) clay films on faces of peds; few fine and very fine roots; common fine dark concretions (iron and manganese oxides); neutral.

The solum ranges from 42 to 60 inches in thickness. The mollic epipedon is 10 to 16 inches thick.

The Ap horizon has value of 2 or 3. The Btg horizon has hue of 10YR to 5Y and value of 4 to 6. It typically is silty clay loam, but ranges in clay content from 35 to 42 percent. The 2Btgb horizon has hue of 10YR to 5Y and value of 4 or 5. It is silty clay or clay. Some pedons do not have a 2Btgb horizon.

The Clearfield soil in map unit 69C2 is a taxadjunct to the Clearfield series because this soil does not have a mollic epipedon, which is definitive for the Clearfield series.

Colo Series

The Colo series consists of poorly drained, moderately permeable soils on bottom land and alluvial fans and along upland drainageways. These soils formed in silty alluvium. Native vegetation was grasses tolerant of wetness. Slopes range from 0 to 5 percent.

Typical pedon of Colo silty clay loam, 0 to 2 percent slopes, in pasture; about 1,570 feet south and 2,145 feet east of the northwest corner of sec. 21, T. 72 N., R. 26 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam (32 percent clay), very dark gray (10YR 3/1) dry; moderate fine and very fine granular structure; friable; common medium and many fine and very fine roots; neutral; clear smooth boundary.

A1—9 to 27 inches; black (N 2/0) silty clay loam (31 percent clay), very dark gray (10YR 3/1) dry; weak fine and very fine subangular blocky structure parting to moderate fine and very fine granular; friable; common medium and many fine and very fine roots; neutral; gradual smooth boundary.

A2—27 to 35 inches; black (10YR 2/1) silty clay loam (36 percent clay), dark gray (10YR 4/1) dry; black (N 2/0) faces of peds; weak fine prismatic structure parting to weak fine and very fine subangular blocky; friable; few medium and many fine and very fine roots; few fine dark concretions (iron and manganese oxides); neutral; gradual smooth boundary.

BA—35 to 41 inches; very dark gray (10YR 3/1) silty clay loam (35 percent clay), dark gray (10YR 4/1) dry; black (10YR 2/1) faces of peds; few fine prominent strong brown (7.5YR 4/6) mottles; weak medium prismatic structure parting to weak fine and medium subangular blocky; friable; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); neutral; gradual smooth boundary.

Bg—41 to 49 inches; very dark gray (10YR 3/1) silty clay loam (35 percent clay); dark gray (10YR 4/1) faces of peds; common fine prominent strong brown (7.5YR 4/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); neutral; gradual smooth boundary.

BCg—49 to 57 inches; gray (10YR 5/1) silty clay loam (33 percent clay); dark gray (10YR 4/1) faces of peds, very dark gray (10YR 3/1) in root channels; common fine prominent strong brown (7.5YR 4/6) mottles; weak medium prismatic structure; friable; few fine and very fine roots; common fine dark concretions (iron and manganese oxides); neutral; gradual smooth boundary.

Cg—57 to 60 inches; gray (5Y 5/1) silty clay loam (32 percent clay); few fine prominent strong brown (7.5YR 4/6) mottles; massive; friable; few fine and very fine roots; common fine dark concretions (iron and manganese oxides); neutral.

The solum ranges from 36 to 60 inches or more in thickness. The mollic epipedon is 36 inches or more in thickness.

The A horizon typically has hue of 10YR or N and value of 2 or 3. The Bg horizon has hue of 10YR or 5Y and value of 3 or 4. The BCg and Cg horizons have hue of 10YR to 5Y, value of 3 to 5, and chroma of 2 or less. The Bg and BCg horizons are silty clay loam and 30 to 35 percent clay.

Edina Series

The Edina series consists of poorly drained, very slowly permeable soils in depressional areas of moderately wide, upland divides. These soils formed in loess. Native vegetation was tall prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Edina silt loam, 0 to 2 percent slopes, in cropland; 240 feet west and 1,920 feet north of the southeast corner of sec. 26, T. 71 N., R. 24 W.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) silt loam (23 percent clay), grayish brown (10YR 5/2) dry; moderate fine and medium granular structure; friable; few medium and many fine roots; common fine dark concretions (iron and manganese oxides); neutral; abrupt smooth boundary.

E—10 to 14 inches; grayish brown (10YR 5/2) silt loam (22 percent clay); very dark grayish brown (10YR 3/2) coatings on faces of peds; moderate medium and thin platy structure; friable; many white (10YR 8/1) dry silt coatings on faces of peds; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); neutral; clear smooth boundary.

EB—14 to 18 inches; dark grayish brown (10YR 4/2) silty clay loam (31 percent clay); very dark gray (10YR 3/1) coatings on faces of peds; moderate medium and thin platy structure; friable; many white (10YR 8/1) dry silt coatings on faces of peds; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); slightly acid; clear smooth boundary.

Bt—18 to 24 inches; very dark gray (10YR 3/1) silty clay (51 percent clay); common fine distinct yellowish brown (10YR 5/6) and many fine faint dark gray (10YR 4/1) mottles; moderate fine and medium subangular blocky structure; very firm; many distinct black (10YR 2/1) organic coatings embedded in clay films on faces of peds; common light gray (10YR 7/1) dry silt coatings on faces of peds; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); medium acid; clear smooth boundary.

Btg1—24 to 29 inches; dark gray (10YR 4/1) silty clay (54 percent clay); common fine distinct yellowish brown (10YR 5/6) and brown (7.5YR 4/4) mottles; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; very firm; many distinct very dark gray (10YR 3/1) clay films on faces of peds; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Btg2—29 to 38 inches; dark grayish brown (2.5Y 4/2) silty clay (49 percent clay); common fine prominent strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; very firm; many distinct dark gray (10YR 4/1) clay films on faces of peds; very dark gray (10YR 3/1) organic coatings in root channels; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Btg3—38 to 48 inches; grayish brown (2.5Y 5/2) silty clay (44 percent clay); many fine prominent strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure; very firm; common faint dark grayish brown (2.5Y 4/2) clay films on faces of prisms and very dark gray (10YR 3/1) organic coatings in root channels; few fine and very fine roots; common fine dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

BCg—48 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam (39 percent clay); many fine prominent strong brown (7.5YR 5/6) and many fine faint light brownish gray (2.5Y 6/2) mottles; weak medium prismatic structure; firm; few fine and very fine roots; many fine dark concretions and stains (iron and manganese oxides); neutral.

The solum ranges from 40 to 60 inches or more in thickness. The mollic epipedon is 10 to 18 inches thick.

The Ap or A horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has value of 4 or 5 and chroma of 1 or 2. The upper part of the Bt horizon has hue of 10YR or 2.5Y and value of 2 to 4. The lower part of the Bt horizon has hue of 10YR to 5Y, value of 3 to 5, and chroma of 1 or 2. The clay content of the control section is between 40 and 55 percent.

Gara Series

The Gara series consists of moderately well drained, moderately slowly permeable soils on convex, valley side slopes and narrowly dissected interfluves on uplands. These soils formed in glacial till. Native vegetation was mixed prairie grasses and deciduous trees. Slopes range from 9 to 25 percent.

These soils are taxadjuncts to the Gara series because they have a higher clay content in the argillic horizon than is defined for the series. The Gara soil in map unit 179E3 is also a taxadjunct to the Gara series because this soil does not have a dark colored surface layer, which is definitive for the Gara series.

Typical pedon of Gara loam, 18 to 25 percent slopes, in woodland; 1,980 feet south and 200 feet east of the northwest corner of sec. 20, T. 72 N., R. 27 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) loam (21 percent clay), grayish brown (10YR 5/2) dry; very dark grayish brown (10YR 3/2) organic coatings on faces of peds; moderate fine and very fine granular structure; friable; common medium and many fine roots; about 3 percent pebbles; slightly acid; abrupt smooth boundary.

EB—7 to 10 inches; dark grayish brown (10YR 4/2) and yellowish brown (10YR 5/4) loam (24 percent clay); few very dark grayish brown (10YR 3/2) organic coatings on faces of peds; weak medium platy structure parting to weak fine subangular blocky; friable; many light gray (10YR 7/2) dry silt coatings and very fine uncoated sand grains on faces of peds; few medium and many fine roots; few fine dark concretions (iron and manganese oxides); medium acid; clear smooth boundary.

Bt1—10 to 14 inches; yellowish brown (10YR 5/4) clay loam (31 percent clay); common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine and very fine subangular blocky structure; friable; common distinct brown (10YR 4/3) clay films on faces of peds; common light gray (10YR 7/2) dry silt and very fine sand coatings on faces of peds; common medium and many fine and very fine roots; common fine dark concretions (iron and manganese oxides); about 3 percent pebbles; strongly acid; clear smooth boundary.

Bt2—14 to 25 inches; dark yellowish brown (10YR 4/4) clay (42 percent clay); common fine prominent strong brown (7.5YR 5/8) mottles; strong fine and medium subangular and angular blocky structure; very firm; many distinct brown (7.5YR 4/4) clay films on faces of peds; few medium and common fine and very fine roots; common fine dark concretions (iron and manganese oxides); about 4 percent pebbles; strongly acid; gradual smooth boundary.

Bt3—25 to 31 inches; yellowish brown (10YR 5/4) clay (41 percent clay); common fine prominent grayish brown (2.5Y 5/2) and common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; very firm; many distinct brown (10YR 4/3) clay films on faces of peds; common fine and very fine roots; common fine and medium dark concretions (iron and manganese oxides); about 4 percent pebbles; medium acid; gradual smooth boundary.

Bt4—31 to 36 inches; yellowish brown (10YR 5/6) clay loam (36 percent clay); common fine and medium prominent grayish brown (2.5Y 5/2) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; common distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; common fine and very fine roots; common fine and medium dark concretions and stains (iron and manganese oxides); few accumulations and nodules of carbonates; about 6 percent pebbles; slightly effervescent; mildly alkaline; gradual smooth boundary.

Bt5—36 to 46 inches; yellowish brown (10YR 5/4) clay loam (34 percent clay); common medium prominent grayish brown (2.5Y 5/2) and common fine prominent strong brown (7.5YR 4/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; common distinct brown (10YR 4/3) clay films on faces of peds; common fine and very fine roots; common fine dark concretions and stains (iron and manganese oxides); common accumulations and nodules of carbonates; about 6 percent pebbles; strongly effervescent; mildly alkaline; gradual smooth boundary.

BC—46 to 60 inches; yellowish brown (10YR 5/4) clay loam (32 percent clay); many medium prominent grayish brown (2.5Y 5/2) and common fine prominent strong brown (7.5YR 5/6) mottles; weak medium prismatic structure; firm; common distinct brown (7.5YR 4/4) clay films on faces of prisms; few fine roots; common fine dark concretions and stains (iron and manganese oxides); common accumulations and nodules of carbonates; about 5 percent pebbles; strongly effervescent; mildly alkaline.

The solum ranges from 40 to more than 60 inches in thickness. These soils commonly are calcareous below a depth of 30 inches.

The A or Ap horizon has chroma of 1 or 2. It is loam, silt loam, or clay loam. Some pedons have an E horizon that has value of 4 or 5 and chroma of 2 or 3, and is loam or silt loam. The Bt horizon has hue of 10YR or 7.5YR and chroma of 3 to 6. The BC horizon has value of 4 or 5 and chroma of 4 to 6. The clay content of the control section is between 35 and 42 percent.

Grundy Series

The Grundy series consists of somewhat poorly drained, slowly permeable soils on slightly convex ridgetops and the upper part of side slopes on uplands. These soils formed in loess. Native vegetation was tall prairie grasses. Slopes range from 2 to 5 percent.

Typical pedon of Grundy silty clay loam, 2 to 5 percent slopes, in cropland; 110 feet north and 90 feet east of the southwest corner of sec. 12, T. 71 N., R. 26 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam (29 percent clay), dark gray (10YR 4/1) dry; moderate fine and medium granular structure; friable; many fine and very fine and common medium roots; neutral; clear smooth boundary.

A—9 to 12 inches; black (10YR 2/1) silty clay loam (31 percent clay), dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to moderate fine and very fine granular; friable; few light brownish gray (10YR 6/2) dry silt coatings on faces of peds; common fine and very fine and few medium roots; slightly acid; clear smooth boundary.

AB—12 to 15 inches; very dark gray (10YR 3/1) silty clay loam (34 percent clay), grayish brown (10YR 5/2) dry; very dark grayish brown (10YR 3/2) worm casts and common black (10YR 2/1) organic coatings on faces of peds; moderate very fine and fine subangular blocky structure; friable; common fine and very fine and few medium roots; medium acid; clear smooth boundary.

Bt1—15 to 19 inches; dark grayish brown (10YR 4/2) silty clay (40 percent clay); few very dark gray (10YR 3/1) organic coatings on faces of peds; common fine distinct yellowish brown (10YR 5/6) mottles; moderate very fine and fine subangular blocky structure; firm; many distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; common fine and very fine roots; few fine dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Bt2—19 to 29 inches; dark grayish brown (2.5Y 4/2) silty clay (46 percent clay); many medium faint light olive brown (2.5Y 5/4) and common fine prominent yellowish brown (10YR 5/6) mottles; moderate fine and medium subangular blocky structure; very firm; many prominent dark gray (10YR 4/1) clay films on faces of peds; common fine and very fine roots; common fine dark concretions and stains (iron and manganese oxides); medium acid; gradual smooth boundary.

Bt3—29 to 36 inches; grayish brown (2.5Y 5/2) silty clay (40 percent clay); common fine and medium faint light olive brown (2.5Y 5/4) and common fine prominent yellowish brown (10YR 5/6) mottles; moderate fine and medium prismatic structure parting to moderate fine and medium subangular blocky; firm; common distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; dark gray (10YR 4/1) organic coatings in root channels; common very fine and fine roots; common fine dark concretions and stains (iron and manganese oxides); slightly acid; gradual smooth boundary.

Bt4—36 to 41 inches; grayish brown (2.5Y 5/2) silty clay loam (36 percent clay); common fine distinct olive (5Y 5/4) and few fine prominent yellowish brown (10YR 5/6) mottles; weak fine and medium prismatic structure; firm; common faint gray (5Y 5/1) clay films on faces of prisms; dark gray (10YR 4/1) organic coatings in root channels; few very fine and fine roots; common fine dark concretions and stains (iron and manganese oxides); slightly acid; gradual smooth boundary.

BC—41 to 53 inches; olive gray (5Y 5/2) silty clay loam (34 percent clay); common fine prominent reddish brown (5YR 4/4) mottles; weak medium and coarse prismatic structure; friable; few fine and very fine roots; common fine and medium dark concretions and stains (iron and manganese oxides); neutral; gradual smooth boundary.

C—53 to 60 inches; light olive gray (5Y 6/2) silty clay loam (32 percent clay); common fine prominent yellowish red (5YR 5/6) and brown (7.5YR 4/4) mottles; massive; friable; few very fine and fine roots; common fine dark concretions and stains (iron and manganese oxides); neutral.

The solum ranges from 40 to more than 60 inches in thickness. The mollic epipedon is 12 to 17 inches thick.

The A horizon has value of 2 or 3. It dominantly is silty clay loam, but includes silt loam. 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 clay content of the control section is between 42 and 48 percent. The lower part of the Bt horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. The C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2.

Haig Series

The Haig series consists of poorly drained, slowly permeable soils on moderately broad, upland divides. These soils formed in loess. Native vegetation was tall prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Haig silt loam, 0 to 2 percent slopes, in cropland; 415 feet south and 60 feet east of the northwest corner of sec. 13, T. 71 N., R. 26 W.

Ap—0 to 7 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.

A1—7 to 11 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine granular structure; friable; medium acid; clear smooth boundary.

A2—11 to 15 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure parting to weak fine granular; friable; few thin discontinuous gray (10YR 5/1) dry silt coatings on faces of peds; medium acid; gradual smooth boundary.

BA—15 to 19 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; few fine distinct yellowish brown (10YR 5/4) mottles; moderate fine subangular blocky structure; firm; few thin discontinuous black (10YR 2/1) clay films in lower part; few fine dark brown (7.5YR 3/2) accumulations (manganese oxides); medium acid; clear smooth boundary.

Bt—19 to 24 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; kneaded very dark gray (10YR 3/1) with value slightly higher than 3; common fine distinct yellowish brown (10YR 5/4) mottles; moderate fine subangular blocky structure; very firm; thick continuous black (10YR 2/1) clay films; few fine dark brown (7.5YR 3/2) and dark reddish brown (5YR 2/2) concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Btg1—24 to 31 inches; dark gray (5Y 4/1) silty clay; many fine prominent yellowish brown (10YR 5/4) and olive brown (2.5Y 4/4) mottles; weak fine subangular blocky structure; very firm; thick continuous very dark gray (10YR 3/1) clay films; few fine dark brown (7.5YR 3/2) and dark reddish brown (5YR 2/2) concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Btg2—31 to 41 inches; olive gray (5Y 5/2) silty clay; common fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; weak fine prismatic structure parting to moderate medium subangular blocky; firm; discontinuous very dark gray (10YR 3/1) and dark gray (10YR 4/1) clay films, mainly on prisms; few fine dark brown (7.5YR 3/2) and dark reddish brown (5YR 2/2) concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Btg3—41 to 48 inches; light olive gray (5Y 6/2) silty clay loam; common fine prominent strong brown (7.5YR 5/6) and yellowish brown (10YR 5/4) mottles; weak medium prismatic structure; firm; thin discontinuous very dark gray (10YR 3/1) and dark gray (10YR 4/1) clay films on prisms; many fine tubular pores; many fine dark reddish brown (5YR 2/2) and dark brown (7.5YR 3/2) concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

BCg—48 to 60 inches; light olive gray (5Y 6/2) silty clay loam; common fine prominent strong brown (7.5YR 5/6) and yellowish brown (10YR 5/4) mottles; weak coarse prismatic structure; friable; few discontinuous dark gray (10YR 4/1) clay films on prisms; slightly acid.

The solum ranges from 52 to more than 60 inches in thickness. The mollic epipedon is 20 to 24 inches thick.

The A horizon has hue of 10YR or N, value of 2 or 3, and chroma of 0 or 1. The Ap horizon dominantly is silt loam, but includes silty clay loam. The Bt horizon has hue of 10YR or 2.5Y and value of 3 or 4. The Btg1 horizon has hue of 10YR to 5Y and value of 4 or 5. In some pedons it has hue of 5Y and chroma of 2. The clay content of the control section is between 42 and 48 percent.

Humeston Series

The Humeston series consists of poorly drained, very slowly permeable soils on concave foot slopes and in slightly concave slack water areas on bottom land. These soils formed in alluvium. Native vegetation was tall prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Humeston silt loam, 0 to 2 percent slopes, in cropland; 2,180 feet south and 2,510 feet east of the northwest corner of sec. 22, T. 71 N., R. 26 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silt loam (24 percent clay), dark gray (10YR 4/1) dry; moderate fine granular structure; friable; few medium and many fine and very fine roots; neutral; clear smooth boundary.

A—9 to 16 inches; black (10YR 2/1) silt loam (24 percent clay), dark gray (10YR 4/1) dry; moderate fine and medium granular structure; friable; common light gray (10YR 7/2) dry silt coatings on faces of peds; slightly acid; clear smooth boundary.

E1—16 to 22 inches; dark gray (10YR 4/1) silt loam (21 percent clay), gray (10YR 5/1) dry; many very dark gray (10YR 3/1) organic coatings on faces of peds; moderate medium and thick platy structure; friable; common light gray (10YR 7/1) dry silt coatings on faces of peds; many fine and very fine roots; medium acid; clear smooth boundary.

E2—22 to 28 inches; gray (10YR 5/1) silt loam (20 percent clay), light gray (10YR 7/1) dry; common very dark gray (10YR 3/1) organic coatings on faces of peds; moderate medium and thick platy structure; friable; many white (10YR 8/1) dry silt coatings on faces of peds; many fine and very fine roots; few fine dark concretions (iron and manganese oxides); medium acid; clear smooth boundary.

BE—28 to 36 inches; very dark gray (10YR 3/1) silty clay loam (34 percent clay); few fine distinct brown (7.5YR 4/4) mottles; moderate fine and very fine subangular blocky structure; friable; common distinct black (10YR 2/1) clay films on faces of peds; common white (10YR 8/1) dry silt coatings on faces of peds; common fine and very fine roots; few fine dark concretions (iron and manganese oxides); slightly acid; clear smooth boundary.

Bt1—36 to 48 inches; black (10YR 2/1) silty clay (45 percent clay); few fine prominent strong brown (7.5YR 4/6) mottles; moderate fine and medium prismatic structure parting to moderate fine and medium subangular blocky; very firm; common distinct black (N 2/0) clay films on faces of peds; common fine and very fine roots; few fine dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

Bt2—48 to 55 inches; very dark gray (10YR 3/1) silty clay (43 percent clay); few fine prominent strong brown (7.5YR 4/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; common distinct black (10YR 2/1) clay films on faces of peds; few fine and very fine roots; few fine dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

BCg—55 to 60 inches; dark gray (10YR 4/1) and very dark gray (10YR 3/1) silty clay loam (38 percent clay); few fine prominent strong brown (7.5YR 4/6) mottles; weak medium prismatic structure; firm; common faint very dark gray (10YR 3/1) clay films on faces of prisms; few fine and very fine roots; few fine dark concretions (iron and manganese oxides); slightly acid.

The solum typically is more than 60 inches thick.

The E horizon is silt loam that has a clay content ranging from 20 to 25 percent. The BE horizon has value of 2 to 4. It is silty clay loam that has a clay content ranging from 30 to 35 percent. The Bt horizon has hue of N or 10YR and chroma of 0 or 1. It is silty clay loam or silty clay that has a clay content ranging from 35 to 48 percent. The BCg horizon has value of 3 or 4.

Keswick Series

The Keswick series consists of moderately well drained, slowly permeable soils on convex narrow ridgetops, short convex side slopes, and convex nose slopes on uplands. These soils formed in a thin mantle of loess and pedisediments and in the underlying paleosol that weathered from glacial till. Native vegetation was deciduous trees. Slopes range from 9 to 14 percent.

Typical pedon of Keswick loam, 9 to 14 percent slopes, in woodland; 535 feet north and 225 feet west of the southeast corner of sec. 9, T. 71 N., R. 24 W.

A—0 to 3 inches; very dark gray (10YR 3/1) loam (18 percent clay), grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; many fine and common medium roots; slightly acid; abrupt smooth boundary.

E—3 to 9 inches; brown (10YR 5/3) loam (18 percent clay); few very dark grayish brown (10YR 3/2) organic coatings on faces of peds; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium platy structure; friable; common white (10YR 8/2) dry silt coatings and very fine uncoated sand grains on faces of peds; common fine and few medium roots; few fine dark concretions (iron and manganese oxides); very strongly acid; clear smooth boundary.

Bt1—9 to 14 inches; yellowish brown (10YR 5/6) loam (26 percent clay); common fine prominent reddish brown (5YR 4/4) and strong brown (7.5YR 5/6) mottles; moderate very fine and fine subangular blocky structure; friable; common distinct brown (7.5YR 4/4) clay films on faces of peds; common light brownish gray (10YR 6/2) dry silt coatings and very fine uncoated sand grains on faces of peds; common fine and few medium roots; few fine dark concretions (iron and manganese oxides); weak stone line at the base of the horizon; very strongly acid; abrupt smooth boundary.

2Bt2—14 to 25 inches; yellowish red (5YR 5/6) and red (2.5YR 4/6) clay (57 percent clay); common fine prominent grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) mottles; strong fine and medium subangular and angular blocky structure; very firm; many distinct dark reddish brown (5YR 3/4) clay films on faces of peds; common fine and few medium roots; few fine dark concretions (iron and manganese oxides); about 4 percent pebbles; very strongly acid; gradual smooth boundary.

2Bt3—25 to 30 inches; strong brown (7.5YR 5/6) and gray (10YR 5/1) clay (46 percent clay); common fine prominent red (2.5YR 4/6) and common fine distinct yellowish brown (10YR 5/4) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; very firm; common distinct brown (7.5YR 4/4) clay films on faces of peds; common fine and few medium roots; few fine dark concretions (iron and manganese oxides); about 3 percent pebbles; very strongly acid; gradual smooth boundary.

2Bt4—30 to 39 inches; strong brown (7.5YR 5/6) and gray (10YR 5/1) clay (40 percent clay); common fine prominent yellowish red (5YR 4/6) mottles; moderate fine and medium prismatic structure; very firm; common distinct dark yellowish brown (10YR 4/4) clay films on faces of prisms; few fine and medium roots; common fine dark concretions and stains (iron and manganese oxides); about 4 percent pebbles; strongly acid; gradual smooth boundary.

2Bt5—39 to 45 inches; yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) clay loam (38 percent clay); many fine and medium prominent strong brown (7.5YR 5/8) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; firm; common distinct brown (10YR 4/3) clay films on faces of peds; few fine and medium roots; common fine dark concretions and stains (iron and manganese oxides); few accumulations of carbonates; about 4 percent pebbles; neutral; gradual smooth boundary.

2BC—45 to 60 inches; yellowish brown (10YR 5/6) and gray (5Y 5/1) clay loam (34 percent clay); common fine prominent strong brown (7.5YR 5/8) mottles; weak medium prismatic structure; firm; few fine and very fine roots; common fine dark concretions and stains (iron and manganese oxides); common fine and medium nodules and accumulations of carbonate bands 1 to 2 inches thick; about 5 percent pebbles; strongly effervescent; mildly alkaline.

The solum ranges from 42 inches to more than 60 inches in thickness.

The A horizon has chroma of 1 or 2. It is 3 to 5 inches thick. The E horizon has value of 4 or 5 and chroma of 2 or 3. Some pedons have an Ap horizon that has chroma of 2 or 3. The upper part of the 2Bt horizon has hue of 2.5YR to 7.5YR, value of 4 or 5, and chroma of 3 to 6. The lower part has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 to 6.

Ladoga Series

The Ladoga series consists of moderately well drained, moderately slowly permeable soils on convex ridgetops and side slopes on uplands. These soils formed in loess. Native vegetation was mixed prairie grasses and deciduous trees. Slopes range from 5 to 9 percent.

Typical pedon of Ladoga silty clay loam, 5 to 9 percent slopes, moderately eroded, in cropland; 825 feet north and 990 feet east of the southwest corner of sec. 7, T. 73 N., R. 26 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silty clay loam (28 percent clay), grayish brown (10YR 5/2) dry; mixed with streaks and pockets of brown (10YR 4/3) subsoil material; weak fine granular structure; friable; few medium and many fine and very fine roots; neutral; abrupt smooth boundary.

Bt1—7 to 11 inches; brown (10YR 4/3) silty clay loam (36 percent clay); common very dark grayish brown (10YR 3/2) organic coatings on faces of peds and in root channels; moderate fine and very fine subangular blocky structure; friable; common distinct brown (10YR 4/3) clay films on faces of peds; common light brownish gray (10YR 6/2) dry silt coatings on faces of peds; few medium and many fine and very fine roots; few fine dark concretions (iron and manganese oxides); slightly acid; clear smooth boundary.

Bt2—11 to 16 inches; dark yellowish brown (10YR 4/4) silty clay loam (39 percent clay); strong fine and very fine subangular and angular blocky structure; firm; many distinct brown (10YR 4/3) clay films on faces of peds; common light brownish gray (10YR 6/2) dry silt coatings on faces of peds; few medium and many fine and very fine roots; few dark concretions (iron and manganese oxides); strongly acid; clear smooth boundary.

Bt3—16 to 21 inches; dark yellowish brown (10YR 4/4) silty clay (41 percent clay); moderate medium subangular blocky structure parting to strong fine subangular blocky; firm; many distinct brown (10YR 4/3) clay films on faces of peds; few medium and many fine and very fine roots; few fine dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

Bt4—21 to 27 inches; dark yellowish brown (10YR 4/4) silty clay (40 percent clay); moderate fine prismatic structure parting to moderate fine and medium subangular blocky; firm; many distinct brown (10YR 4/3) clay films on faces of peds; many fine and very fine roots; common fine dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

Bt5—27 to 32 inches; yellowish brown (10YR 5/4) silty clay loam (38 percent clay); common fine distinct strong brown (7.5YR 4/6) and grayish brown (2.5Y 5/2) mottles; moderate medium prismatic structure parting to moderate medium and fine subangular blocky; firm; many distinct brown (10YR 4/3) clay films on faces of peds; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

Bt6—32 to 47 inches; yellowish brown (10YR 5/4) and grayish brown (2.5Y 5/2) silty clay loam (35 percent clay); common fine prominent strong brown (7.5YR 5/6) and brown (7.5YR 4/4) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; friable; common distinct brown (10YR 4/3) clay films on faces of peds; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

BC—47 to 54 inches; yellowish brown (10YR 5/4) and grayish brown (2.5Y 5/2) silty clay loam (33 percent clay); common fine prominent strong brown (7.5YR 4/6) mottles; weak medium prismatic structure; friable; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

C—54 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam (31 percent clay); many fine prominent yellowish brown (10YR 5/6) and common fine prominent strong brown (7.5YR 4/6 and 5/8) mottles; massive with a few vertical cleavage planes; friable; few fine and very fine roots; common fine dark concretions (iron and manganese oxides); strongly acid.

The solum ranges from 42 to 60 inches in thickness.

The A or Ap horizon has value of 2 or 3 and chroma of 1 or 2. The upper part of the Bt horizon has value of 4 or 5 and chroma of 3 or 4. The lower part of the Bt horizon and the BC horizon have hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. The Bt horizon is silty clay loam and silty clay, and has a clay maximum ranging from 35 to 42 percent. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4.

Lamoni Series

The Lamoni series consists of somewhat poorly drained, slowly permeable soils on convex side slopes and narrow convex ridgetops on uplands. These soils formed in a paleosol weathered from glacial till. Native vegetation was tall prairie grasses. Slopes range from 5 to 14 percent.

Typical pedon of Lamoni clay loam, 9 to 14 percent slopes, in pasture; 790 feet south and 1,585 feet east of the northwest corner of sec. 26, T. 72 N., R. 25 W.

Ap—0 to 10 inches; black (10YR 2/1) clay loam (28 percent clay), dark gray (10YR 4/1) dry; moderate fine and very fine granular structure; friable; few medium and many fine and very fine roots; medium acid; clear smooth boundary.

A—10 to 14 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) clay loam (34 percent clay), dark grayish brown (10YR 4/2) dry; brown (10YR 4/3) faces of peds; weak fine and very fine subangular blocky structure parting to moderate fine granular; friable; few medium and many fine and very fine roots; brown (7.5YR 4/4) worm casts; medium acid; clear smooth boundary.

2Bt1—14 to 19 inches; dark grayish brown (10YR 4/2) clay loam (39 percent clay); very dark gray (10YR 3/1) faces of some peds and linings of pores and root channels; common fine distinct strong brown (7.5YR 4/6) and brown (7.5YR 4/4) mottles; moderate fine and very fine subangular blocky structure; firm; common faint dark grayish brown (10YR 4/2) clay films on faces of peds; few medium and many fine and very fine roots; common fine dark concretions (iron and manganese oxides); about 2 percent pebbles; medium acid; gradual smooth boundary.

2Bt2—19 to 23 inches; grayish brown (2.5Y 5/2) clay (43 percent clay); very dark gray (10YR 3/1) faces of some peds and root channels; common fine distinct yellowish brown (10YR 5/6) and common fine prominent strong brown (7.5YR 4/6) and reddish brown (5YR 4/4) mottles; moderate fine and very fine subangular blocky structure; very firm; many distinct dark gray (10YR 4/1) clay films on faces of peds; many fine and very fine roots; common fine dark concretions (iron and manganese oxides); about 3 percent pebbles; medium acid; gradual smooth boundary.

2Bt3—23 to 32 inches; yellowish brown (10YR 5/6) and light gray (10YR 6/1) clay (42 percent clay); common fine distinct strong brown (7.5YR 4/6) and few fine prominent reddish brown (5YR 4/4) mottles; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; very firm; common distinct dark gray (10YR 4/1) clay films on faces of peds; many fine and very fine roots; common fine dark concretions (iron and manganese oxides); about 2 percent fine pebbles; slightly acid; gradual smooth boundary.

2Bt4—32 to 40 inches; yellowish brown (10YR 5/6) and light gray (10YR 6/1) clay loam (38 percent clay); common fine distinct strong brown (7.5YR 4/6) and few fine prominent reddish brown (5YR 4/4) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; common faint dark yellowish brown (10YR 4/4) clay films on faces of peds; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); about 3 percent fine pebbles; slightly acid; gradual smooth boundary.

2BC—40 to 52 inches; yellowish brown (10YR 5/6) and light gray (5Y 6/1) clay loam (37 percent clay); common fine distinct strong brown (7.5YR 4/6) and brown (7.5YR 4/4) and few fine prominent reddish brown (5YR 4/4) mottles; weak medium prismatic structure parting to moderate medium and coarse subangular blocky; firm; common faint grayish brown (2.5Y 5/2) clay films on faces of peds; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); about 3 percent fine pebbles; slightly acid; gradual smooth boundary.

2C—52 to 60 inches; yellowish brown (10YR 5/6) and light gray (5Y 6/1) clay loam (32 percent clay); common fine distinct strong brown (7.5YR 5/6) and few fine prominent reddish brown (5YR 4/4) mottles; weak coarse prismatic structure; friable; common fine and very fine roots; many fine and medium dark concretions (iron and manganese oxides); about 2 percent fine pebbles; neutral.

The solum ranges from 48 to more than 60 inches in thickness. In uneroded soils the mollic epipedon is 10 to 16 inches thick.

The A horizon has chroma of 1 or 2. It typically is clay loam, but the range includes silty clay loam. The upper part of the 2Bt horizon has chroma of 2 to 4. The lower part has hue of 10YR to 5Y, value of 5 or 6, and chroma of 1 to 6. Only mottles have hue redder than 10YR.

The Lamoni soils in map units 822C2, 822C3, 822D2, and 822D3 are taxadjuncts to the Lamoni series because these soils do not have a mollic epipedon, which is definitive for the Lamoni series.

Lawson Series

The Lawson series consists of somewhat poorly drained, moderately permeable soils on bottom land. These soils formed in silty alluvium. Native vegetation was tall prairie grasses and scattered hardwood trees. Slopes range from 0 to 2 percent.

Typical pedon of Lawson silt loam, 0 to 2 percent slopes, in cropland; 2,190 feet south and 555 feet east of the northwest corner of sec. 10, T. 71 N., R. 24 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine and very fine granular structure; friable; common fine and very fine roots; neutral; clear smooth boundary.

A1—9 to 19 inches; very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; very dark grayish brown (10YR 3/2) coatings on faces of peds; few fine faint dark brown (10YR 3/3) mottles; weak fine subangular blocky structure parting to moderate fine granular; friable; common fine and very fine and few medium roots; neutral; gradual smooth boundary.

A2—19 to 30 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; common fine faint dark brown (10YR 3/3) and dark yellowish brown (10YR 4/4) mottles; moderate fine subangular blocky structure; friable; common light gray (10YR 7/2) dry silt coatings on faces of peds; common fine and very fine roots; neutral; gradual smooth boundary.

C1—30 to 42 inches; very dark grayish brown (10YR 3/2) silt loam; stratified with thin lenses of loam; common fine faint dark brown (10YR 3/3) and dark yellowish brown (10YR 4/4) mottles; weak fine and medium subangular blocky structure; friable; common light gray (10YR 7/2) dry silt coatings on faces of peds; common fine and very fine roots; neutral; gradual smooth boundary.

C2—42 to 60 inches; dark grayish brown (10YR 4/2) silt loam; common fine distinct yellowish brown (10YR 5/4) mottles; massive; friable; common fine and very fine roots; slightly acid.

The solum, or A horizon, ranges from 24 to 36 inches in thickness.

The A horizon has chroma of 1 or 2. It typically is silt loam, but ranges to silty clay loam. It has a clay content of 18 to 30 percent. The C horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 2 or 3. It is silt loam or loam.

Lindley Series

The Lindley series consists of moderately well drained, moderately slowly permeable soils on convex valley side slopes and narrowly dissected interfluves on uplands. These soils formed in glacial till. Native vegetation was deciduous trees. Slopes range from 9 to 40 percent.

These soils are taxadjuncts to the Lindley series because they have a higher clay content in the argillic horizon than is defined for the series. Also, the clay content in the A and E horizons is less than is defined for the series.

Typical pedon of Lindley loam, 25 to 40 percent slopes, in woodland; 2,375 feet north and 1,120 feet east of the southwest corner of sec. 35, T. 71 N., R. 27 W.

A—0 to 3 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) loam (16 percent clay), grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; common medium and many fine and very fine roots; neutral; abrupt smooth boundary.

E1—3 to 7 inches; brown (10YR 5/3) loam (15 percent clay), pale brown (10YR 6/3) dry; common very dark grayish brown (10YR 3/2) organic coatings on faces of peds; common faint yellowish brown (10YR 5/4) mottles; moderate medium platy structure; friable; many light gray (10YR 7/2) dry coatings of silt and very fine uncoated sand grains on the horizontal faces of platy peds; few coarse and many fine and very fine roots; medium acid; clear smooth boundary.

E2—7 to 11 inches; brown (10YR 5/3) and grayish brown (10YR 5/2) loam (15 percent clay), light gray (10YR 7/2) dry; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium and thick platy structure; friable; many white (10YR 8/2) dry coatings of silt and very fine uncoated sand grains on the horizontal faces of platy peds; few medium and many fine and very fine roots; strongly acid; clear smooth boundary.

Bt1—11 to 18 inches; yellowish brown (10YR 5/4) clay loam (28 percent clay); common fine distinct yellowish brown (10YR 5/6) mottles; strong fine and very fine subangular and angular blocky structure; friable; common distinct brown (10YR 4/3) clay films on faces of peds; common light gray (10YR 7/2) dry coatings of silt and very fine uncoated sand grains on faces of peds; few coarse and many fine and very fine roots; about 3 percent fine pebbles; very strongly acid; clear smooth boundary.

Bt2—18 to 23 inches; yellowish brown (10YR 5/6 and 5/8) clay (42 percent clay); common fine distinct strong brown (7.5YR 4/6) mottles; moderate fine and very fine subangular blocky structure; very firm; many distinct brown (10YR 4/3) clay films on faces of peds; few coarse and common fine and very fine roots; about 3 percent very fine pebbles; very strongly acid; gradual smooth boundary.

Bt3—23 to 31 inches; strong brown (7.5YR 5/6) clay loam (39 percent clay); common fine distinct grayish brown (10YR 5/2) mottles; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; very firm; many distinct brown (10YR 4/3) clay films on faces of peds; few coarse and common fine and very fine roots; few fine dark concretions (iron and manganese oxides); about 3 percent fine pebbles; very strongly acid; gradual smooth boundary.

Bt4—31 to 39 inches; yellowish brown (10YR 5/6) clay loam (35 percent clay); common fine distinct strong brown (7.5YR 4/6 and 5/8) and brown (7.5YR 5/2) mottles; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; firm; many distinct brown (10YR 4/3) clay films on faces of peds; few coarse and common fine and very fine roots; few fine dark concretions (iron and manganese oxides); about 4 percent fine pebbles; slightly acid; gradual smooth boundary.

Bt5—39 to 49 inches; yellowish brown (10YR 5/4) clay loam (30 percent clay); common fine and medium distinct strong brown (7.5YR 4/6 and 5/8) and grayish brown (10YR 5/2) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; common distinct brown (10YR 4/3) clay films on faces of peds; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); common soft accumulations and nodules (calcium carbonates); about 5 percent pebbles; slightly effervescent; mildly alkaline; gradual smooth boundary.

BC—49 to 56 inches; yellowish brown (10YR 5/4) clay loam; common fine distinct strong brown (7.5YR 4/6 and 5/8) and common fine prominent light brownish gray (2.5Y 6/2) mottles; weak medium prismatic structure; firm; common faint dark grayish brown (10YR 4/2) clay films on faces of peds; few fine and very fine roots; common fine dark concretions and stains (iron and manganese oxides); common soft accumulations and nodules (calcium carbonates); about 5 percent pebbles; strongly effervescent; mildly alkaline; gradual smooth boundary.

C—56 to 60 inches; light brownish gray (2.5Y 6/2) clay loam; faces of peds grayish brown (2.5Y 5/2); many fine and medium distinct light olive brown (2.5Y 5/4) and yellowish brown (10YR 5/6) mottles; massive with pressure faces; firm; few fine and very fine roots; common fine and medium dark concretions and stains (iron and manganese oxides); common soft accumulations and nodules (calcium carbonates); about 5 percent pebbles; strongly effervescent; mildly alkaline.

The solum ranges from 36 to 60 inches in thickness. Free carbonates generally are present below a depth of 36 inches.

The A horizon has value of 3 or 4 and chroma of 1 or 2. The E horizon has value of 4 to 6 and chroma of 2 to 4. Some pedons have an Ap horizon that generally incorporates the A and E horizons and has value of 4 or 5 and chroma of 2 to 4. It dominantly is loam, but includes silt loam or clay loam. The Bt horizon has value of 4 or 5 and chroma of 4 to 8. It is clay loam or clay, and the content of clay averages between 35 and 42 percent. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. It is clay loam or loam.

Lineville Series

The Lineville series consists of moderately well drained, slowly permeable soils on short, convex side slopes, narrow, convex ridgetops, and convex nose slopes on uplands. These soils formed in loess and in the underlying erosional sediments and paleosol weathered from glacial till. Native vegetation was prairie grasses and deciduous trees. Slopes range from 5 to 9 percent.

Typical pedon of Lineville silt loam, 5 to 9 percent slopes, moderately eroded, in pasture; 530 feet north and 1,980 feet east of the southwest corner of sec. 30, T. 72 N., R. 27 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; mixed with streaks and pockets of brown (10YR 4/3) silty clay loam subsoil material; moderate fine and very fine granular structure; friable; common medium and many fine and very fine roots; slightly acid; abrupt smooth boundary.

Bt1—7 to 11 inches; brown (10YR 4/3) silty clay loam; common very dark grayish brown (10YR 3/2) organic coatings on faces of peds; moderate fine subangular blocky structure; friable; common faint brown (10YR 4/3) clay films on faces of peds; common light gray (10YR 7/2) dry silt coatings on faces of some peds; common medium and many fine and very fine roots; slightly acid; clear smooth boundary.

Bt2—11 to 15 inches; brown (10YR 5/3) silty clay loam; few fine faint grayish brown (10YR 5/2) mottles; moderate fine and very fine subangular blocky structure; friable; many distinct brown (10YR 4/3) clay films on faces of peds; common medium and many fine and very fine roots; medium acid; clear smooth boundary.

Bt3—15 to 19 inches; brown (10YR 4/3) silty clay loam; few fine faint grayish brown (10YR 5/2) mottles; moderate fine and very fine subangular blocky structure; firm; many faint brown (10YR 4/3) clay films on faces of peds; common medium and many fine and very fine roots; few fine dark concretions (iron and manganese oxides); medium acid; clear smooth boundary.

2Bt4—19 to 24 inches; yellowish brown (10YR 5/4) clay loam; common fine distinct brown (7.5YR 4/4) and common fine faint grayish brown (10YR 5/2) mottles; moderate fine and medium subangular blocky structure; firm; common distinct brown (10YR 4/3) clay films on faces of peds; common pale brown (10YR 6/3) dry silt and very fine sand coatings on faces of some peds; common medium and many fine and very fine roots; common fine dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

2Bt5—24 to 37 inches; yellowish brown (10YR 5/4) and dark grayish brown (10YR 4/2) clay loam; common fine prominent brown (7.5YR 4/4) and grayish brown (2.5Y 5/2) mottles; moderate medium prismatic structure parting to moderate medium and fine subangular blocky; firm; common distinct brown

(10YR 4/3) clay films on faces of peds; common light gray (10YR 7/2) dry silt and very fine sand coatings on faces of some peds; few medium and many fine and very fine roots; common fine dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

2Bt6—37 to 45 inches; yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) clay loam; common fine prominent strong brown (7.5YR 4/6) and dark brown (7.5YR 3/2) mottles; moderate medium prismatic structure; firm; common distinct brown (7.5YR 4/4) clay films on faces of peds; common light gray (10YR 7/2) dry silt and very fine sand coatings on faces of some peds; common fine and very fine roots; common fine and medium dark concretions (iron and manganese oxides); few fine pebbles; slightly acid; gradual smooth boundary.

3Bt7—45 to 52 inches; strong brown (7.5YR 5/6) clay loam; common fine prominent yellowish red (5YR 4/6) and light brownish gray (2.5Y 6/2) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; common distinct brown (7.5YR 4/4) clay films on faces of peds; common fine and very fine roots; common fine and medium dark concretions (iron and manganese oxides); common fine pebbles; slightly acid; gradual smooth boundary.

3Bt8—52 to 60 inches; yellowish red (5YR 4/6) clay; common fine prominent strong brown (7.5YR 5/8) and dark reddish brown (2.5YR 3/4) mottles; moderate fine and very fine subangular blocky structure; very firm; common distinct brown (7.5YR 5/2 and 4/2) clay films on faces of peds; few fine and very fine roots; common fine and medium dark concretions (iron and manganese oxides); common fine pebbles; slightly acid.

The solum typically is more than 60 inches thick.

The A or Ap horizon has value of 2 or 3 and chroma of 1 or 2. The upper part of the 2Bt horizon has value of 4 or 5 and chroma of 2 to 4. The lower part has hue of 7.5YR, 10YR, or 2.5Y, value of 4 or 5, and chroma of 2 to 6. The 2Bt horizon is loam or clay loam. It has a clay content of 20 to 35 percent. The upper part of the 3Bt horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 or 6. It is clay loam or clay. It typically has a clay content of about 38 to 43 percent.

Macksburg Series

The Macksburg series consists of somewhat poorly drained, moderately slowly permeable soils on moderately wide ridgetops and on the upper part of side slopes of upland divides. These soils formed in loess. Native vegetation was tall prairie grasses. Slopes range from 0 to 5 percent.

Typical pedon of Macksburg silty clay loam, 0 to 2 percent slopes, in cropland; 1,155 feet north and 660 feet east of the southwest corner of sec. 5, T. 73 N., R. 27 W.

Ap—0 to 10 inches; black (10YR 2/1) silty clay loam (30 percent clay), dark gray (10YR 4/1) dry; moderate fine and very fine granular structure; friable; few medium and many fine and very fine roots; neutral; clear smooth boundary.

A—10 to 15 inches; black (10YR 2/1) silty clay loam (36 percent clay), dark grayish brown (10YR 4/2) dry; brown (10YR 4/3) worm casts on faces of peds; moderate fine and medium granular structure; friable; few medium and many fine and very fine roots; neutral; clear smooth boundary.

AB—15 to 19 inches; very dark grayish brown (10YR 3/2) silty clay loam (37 percent clay), grayish brown (10YR 5/2) dry; many very dark gray (10YR 3/1) organic coatings on faces of peds and in root channels; moderate fine and very fine subangular blocky structure; friable; common faint brown (10YR 4/3) clay films on faces of peds; many fine and very fine roots; medium acid; clear smooth boundary.

Bt1—19 to 24 inches; brown (10YR 4/3) and dark grayish brown (10YR 4/2) silty clay loam (39 percent clay); common very dark gray (10YR 3/1) organic coatings on faces of peds; common fine distinct yellowish brown (10YR 5/4) and grayish brown (10YR 5/2) and few fine distinct strong brown (7.5YR 4/6) mottles; moderate fine and very fine subangular blocky structure; firm; many distinct dark grayish brown (10YR 4/2) clay films on faces of peds; many fine and very fine roots; few fine dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Bt2—24 to 30 inches; grayish brown (10YR 5/2) silty clay (41 percent clay); common fine distinct strong brown (7.5YR 4/6) mottles; moderate medium and fine subangular blocky structure; firm; many distinct dark grayish brown (10YR 4/2) clay films on faces of peds; many fine and very fine roots; common fine dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Bt3—30 to 37 inches; grayish brown (2.5Y 5/2) silty clay loam (37 percent clay); common fine prominent strong brown (7.5YR 4/6) and common fine distinct light brownish gray (2.5Y 6/2) mottles; moderate medium prismatic structure parting to moderate medium and fine subangular blocky; firm; many faint grayish brown (10YR 5/2) clay films on faces of peds; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Bt4—37 to 45 inches; light brownish gray (2.5Y 6/2) silty clay loam (35 percent clay); common fine prominent strong brown (7.5YR 4/6) and common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; friable; common distinct grayish brown (2.5Y 5/2) clay films on faces of peds; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

BC—45 to 54 inches; light brownish gray (2.5Y 6/2) silty clay loam (33 percent clay); many fine prominent strong brown (7.5YR 4/6) and yellowish brown (10YR 5/6) mottles; weak medium prismatic structure; friable; common faint grayish brown (2.5Y 5/2) clay films on faces of peds; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

C—54 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam (31 percent clay); many fine prominent strong brown (7.5YR 4/6) and many fine distinct yellowish brown (10YR 5/6) mottles; massive with a few vertical cleavage faces; friable; few fine and very fine roots; common fine dark concretions (iron and manganese oxides); slightly acid.

The solum ranges from 48 to more than 60 inches in thickness. The mollic epipedon is 16 to 24 inches thick.

The A horizon has chroma of 1 or 2. The AB or BA horizon has value of 2 or 3. Some pedons do not have an AB or BA horizon. The upper part of the Bt horizon typically has value of 4 or 5 and chroma of 2 to 4. The lower part of the Bt horizon has hue of 2.5Y or 5Y and value of 4 to 6. The Bt horizon averages from 35 to 42 percent clay. The BC and C horizons have hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 6.

Mystic Series

The Mystic series consists of moderately well drained and somewhat poorly drained, slowly permeable soils on convex ridgetops and side slopes of high stream terraces that border valleys of major tributaries. These soils formed in weathered alluvium derived from glacial till. Native vegetation was mixed prairie grasses and deciduous trees. Slopes range from 5 to 18 percent.

Typical pedon of Mystic clay loam, 5 to 9 percent slopes, moderately eroded, in cropland; 1,200 feet south and 785 feet east of the northwest corner of sec. 16, T. 73 N., R. 25 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) clay loam (28 percent clay), grayish brown (10YR 5/2) dry; mixed with streaks and pockets of brown (7.5YR 4/4) subsoil material; moderate fine granular structure; friable; few medium and many fine and very fine roots; slightly acid; clear smooth boundary.

Bt1—7 to 14 inches; brown (7.5YR 4/4) clay (44 percent clay); common very dark grayish brown (10YR 3/2) organic coatings on faces of peds; common fine prominent red (2.5YR 4/6) and common fine distinct strong brown (7.5Y 4/6) mottles; strong fine and very fine subangular blocky structure; very firm; common distinct brown (7.5YR 4/2) clay films on faces of peds; few medium and many fine and very fine roots; medium acid; gradual smooth boundary.

Bt2—14 to 21 inches; brown (7.5YR 5/4) clay (48 percent clay); common fine prominent red (2.5YR 4/6) and many fine distinct strong brown (7.5YR 4/6) mottles; moderate fine prismatic structure parting to moderate fine and medium subangular blocky; very firm; common distinct grayish brown (10YR 5/2) clay films on faces of peds; common fine and very fine roots; few fine dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Bt3—21 to 29 inches; yellowish brown (10YR 5/4) and grayish brown (2.5Y 5/2) clay (43 percent clay); few fine prominent red (2.5YR 4/6) and common fine prominent reddish brown (5YR 4/4) and strong brown (7.5YR 4/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; very firm; common distinct grayish brown (10YR 5/2) clay films on faces of peds; few light gray (10YR 7/1) dry very fine uncoated sand grains on faces of peds; common fine and very fine roots; common fine dark concretions and stains (iron and manganese oxides); slightly acid; gradual smooth boundary.

Bt4—29 to 38 inches; grayish brown (2.5Y 5/2) clay (41 percent clay); common fine and medium prominent reddish brown (5YR 4/4) and strong brown (7.5YR 5/6 and 4/6) mottles; moderate medium prismatic structure parting to moderate medium and coarse subangular blocky; firm; common distinct grayish brown (10YR 5/2) clay films on faces of peds; common fine and very fine roots; common fine dark concretions and stains (iron and manganese oxides); common light gray (10YR 7/1) dry very fine uncoated sand grains on faces of peds; slightly acid; gradual smooth boundary.

Bt5—38 to 46 inches; grayish brown (2.5Y 5/2) clay loam (33 percent clay); common fine and medium prominent strong brown (7.5YR 4/6 and 5/8) mottles; moderate medium prismatic structure parting to weak medium and coarse subangular blocky; friable; common faint grayish brown (2.5Y 5/2) clay films on faces of prisms; few fine and very fine roots; common fine dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

BC—46 to 55 inches; strong brown (7.5YR 5/6 and 4/6) clay loam (29 percent clay); many fine and medium prominent grayish brown (2.5Y 5/2) and dark reddish brown (5YR 3/4) mottles; weak medium and coarse prismatic structure; friable; few fine and very fine roots; many fine and medium dark concretions and stains (iron and manganese oxides); neutral; gradual smooth boundary.

C—55 to 60 inches; yellowish brown (10YR 5/4) clay loam (28 percent clay); many fine and medium prominent strong brown (7.5YR 4/6 and 5/8) mottles; massive; friable; common fine and medium dark concretions (iron and manganese oxides); neutral.

The solum ranges from 45 to more than 60 inches in thickness. It does not have free carbonates.

The Ap or A horizon has chroma of 1 or 2. It is silty clay loam, clay loam, silt loam, or loam. The Bt horizon has hue of 2.5YR to 2.5Y, value of 3 to 5, and chroma of 2 to 4. It is clay loam or clay. The BC and C horizons have hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 8. They are clay loam, sandy clay loam, loam, or sandy loam.

Mystic Variant

The Mystic Variant consists of poorly drained, very slowly permeable soils on convex ridgetops and side slopes of high stream terraces that border valleys of major tributaries. These soils formed in highly weathered alluvium derived from glacial till. Native vegetation was mixed prairie grasses and deciduous trees. Slopes range from 5 to 9 percent.

Typical pedon of Mystic Variant silty clay loam, 5 to 9 percent slopes, moderately eroded, in hayland; 130 feet south and 1,190 feet west of the northeast corner of sec. 35, T. 72 N., R. 25 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silty clay loam (35 percent clay), grayish brown (10YR 5/2) dry; mixed with streaks and pockets of grayish brown (10YR 5/2) subsoil material; weak fine granular structure; friable; common medium and many fine and very fine roots; medium acid; clear smooth boundary.

Bt1—8 to 12 inches; grayish brown (10YR 5/2) silty clay (47 percent clay); common fine distinct strong brown (7.5YR 4/6) mottles; moderate fine and very fine subangular blocky structure; very firm; common distinct dark grayish brown (10YR 4/2) clay films on faces of peds; common light gray (10YR 7/2) dry silt coatings on faces of some peds; few medium and many fine and very fine roots; few fine dark concretions (iron and manganese oxides); strongly acid; clear smooth boundary.

Bt2—12 to 17 inches; grayish brown (2.5Y 5/2) silty clay (49 percent clay); common fine prominent strong brown (7.5YR 4/6) and common fine distinct yellowish brown (10YR 5/6) and light brownish gray (2.5Y 6/2) mottles; moderate fine prismatic structure parting to moderate fine and medium subangular blocky; very firm; common distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; common fine dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

Bt3—17 to 24 inches; dark gray (10YR 4/1) and gray (10YR 5/1) silty clay (46 percent clay); common fine and medium prominent brown (7.5YR 4/4) and strong brown (7.5YR 4/6) mottles; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; very firm; many distinct dark grayish brown (10YR 4/2) clay films on faces of peds; few medium and many fine and very fine roots; common fine and medium dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

Bt4—24 to 31 inches; gray (5Y 5/1) silty clay (40 percent clay); common fine and medium strong brown (7.5YR 4/6) and common fine and medium prominent yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; many distinct dark grayish brown (10YR 4/2) clay films on faces of peds; common fine and medium dark concretions and stains (iron and manganese oxides); strongly acid; gradual smooth boundary.

Bt5—31 to 40 inches; light gray (5Y 6/1) clay loam (36 percent clay); many fine and medium prominent yellowish brown (10YR 5/6) and common fine and medium prominent strong brown (7.5YR 4/6) mottles; moderate medium prismatic structure parting to moderate medium and coarse subangular blocky; firm; common distinct brown (7.5YR 4/2) and gray (5Y 5/1) clay films on faces of peds; many fine and very fine roots; common fine and medium dark concretions and stains (iron and manganese oxides); medium acid; gradual smooth boundary.

BC—40 to 60 inches; grayish brown (2.5Y 5/2) clay loam (33 percent clay); common fine and medium prominent and strong brown (7.5YR 4/6) mottles; weak medium prismatic structure parting to moderate medium and coarse subangular blocky; friable; common faint dark grayish brown (10YR 4/2) clay films on faces of peds; common fine and very fine roots; common fine and medium dark concretions and stains (iron and manganese oxides); slightly acid.

The solum ranges from 48 to more than 60 inches in thickness. Free carbonates are not in the solum.

The Ap or A horizon has chroma of 1 or 2. It is silty clay loam or clay loam. The Bt horizon has hue of 10YR to 5Y. It is silty clay loam, silty clay, clay, or clay loam.

Nira Series

The Nira series consists of moderately well drained, moderately permeable soils on convex to straight side slopes and short, narrow ridgetops on uplands. These soils formed in loess. Native vegetation was prairie grasses. Slopes range from 5 to 9 percent.

Typical pedon of Nira silty clay loam, 5 to 9 percent slopes, in cropland; 1,450 feet north and 1,400 feet east of the southwest corner of sec. 20, T. 73 N., R. 27 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; moderate fine and very fine granular structure; friable; common medium and many fine roots; slightly acid; clear smooth boundary.

A—9 to 12 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) silty clay loam; grayish brown (10YR 5/2) dry; dark brown (10YR 3/3) coatings on faces of some peds; weak fine and very fine subangular blocky structure parting to moderate fine granular; friable; few medium and many fine and very fine roots; few fine dark concretions (iron and manganese oxides); slightly acid; clear smooth boundary.

Bw1—12 to 18 inches; brown (10YR 4/3) silty clay loam; many very dark grayish brown (10YR 3/2) coatings on faces of peds; few fine distinct grayish brown (2.5Y 5/2) mottles; moderate fine and very fine subangular blocky structure; friable; many fine and very fine roots; medium acid; gradual smooth boundary.

Bw2—18 to 23 inches; brown (10YR 5/3) and grayish brown (2.5Y 5/2) silty clay loam; few very dark grayish brown (10YR 3/2) coatings on faces of peds; common fine distinct strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to moderate fine and medium subangular blocky; friable; many fine and very fine roots; medium acid; gradual smooth boundary.

Bw3—23 to 29 inches; grayish brown (2.5Y 5/2) silty clay loam; brown (10YR 5/3) coatings on faces of some peds; common fine and medium prominent strong brown (7.5YR 4/6) mottles; friable; many fine and very fine roots; common fine and medium dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Bw4—29 to 40 inches; olive gray (5Y 5/2) silty clay loam; common fine and medium prominent strong brown (7.5YR 5/6) and yellowish red (5YR 4/6) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; friable; common fine and very fine roots; common fine and medium dark concretions and stains (iron and manganese oxides); medium acid; gradual smooth boundary.

BC—40 to 48 inches; light olive gray (5Y 6/2) silty clay loam; common fine and medium prominent strong brown (7.5YR 5/6) and yellowish red (5YR 4/6) mottles; weak medium and coarse prismatic structure; friable; common fine and very fine roots; common fine and medium dark concretions and stains (iron and manganese oxides); medium acid; gradual smooth boundary.

C—48 to 60 inches; light olive gray (5Y 6/2) silt loam; many medium and prominent coarse strong brown (7.5YR 5/8) and yellowish red (5YR 4/6) mottles; massive; some vertical cleavage planes; friable; common fine and very fine roots; common fine and medium dark concretions and stains (iron and manganese oxides); slightly acid.

The solum ranges from 36 to 50 inches in thickness. In uneroded soils the mollic epipedon is 10 to 15 inches thick.

The A horizon has chroma of 1 or 2. In the upper 6 inches the Bw horizon typically has chroma of 3 or 4. The lower part of the Bw horizon and the BC and C horizons have hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 1 or 2. The maximum amount of clay typically is 33 to 38 percent, and is in the upper part of the Bw horizon or the lower part of the A horizon.

The Nira soil in map unit 570C2 is a taxadjunct to the Nira series because this soil does not have a mollic epipedon, which is definitive for the Nira series.

Nodaway Series

The Nodaway series consists of moderately well drained, moderately permeable soils on bottom land near stream channels. These soils formed in stratified, silty and loamy alluvium. Native vegetation was mixed prairie grasses and deciduous trees. Slopes range from 0 to 2 percent.

Typical pedon of Nodaway silt loam, 0 to 2 percent slopes, in cropland; 1,780 feet north and 1,450 feet west of the southeast corner of sec. 36, T. 71 N., R. 27 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; few medium and many fine and very fine roots; neutral; abrupt smooth boundary.

C—9 to 60 inches; stratified dark grayish brown (10YR 4/2), very dark grayish brown (10YR 3/2), grayish brown (10YR 5/2), and very dark gray (10YR 3/1) silt loam; common fine distinct yellowish brown (10YR 5/6) mottles; massive but tending toward platy structure because of stratification; friable; few very thin strata of fine sandy loam or silty clay loam; many fine and very fine roots; neutral.

The Ap or A horizon has chroma of 1 or 2. The C horizon has value of 3 to 5 and chroma of 1 to 3. It is dominantly silt loam, but has thin strata of fine sandy loam, loam, and silty clay loam.

Olmitz Series

The Olmitz series consists of moderately well drained, moderately permeable soils on alluvial fans and slightly concave to straight foot slopes. These soils formed in loamy local alluvium and colluvium. Native vegetation was prairie grasses. Slopes range from 2 to 9 percent.

Typical pedon of Olmitz loam, 5 to 9 percent slopes, in cropland; 1,980 feet north and 495 feet west of the southeast corner of sec. 7, T. 73 N., R. 27 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) loam (25 percent clay), very dark grayish brown (10YR 3/2) dry; moderate fine and very fine granular structure; friable; common medium and many fine and very fine roots; neutral; clear smooth boundary.

A1—9 to 17 inches; very dark brown (10YR 2/2) clay loam (28 percent clay), very dark grayish brown (10YR 3/2) dry; moderate medium and fine granular structure; friable; common medium and many fine and very fine roots; neutral; clear smooth boundary.

A2—17 to 26 inches; very dark brown (10YR 2/2) clay loam (31 percent clay), dark grayish brown (10YR 4/2) dry; moderate fine and medium subangular blocky structure parting to moderate fine and medium granular; friable; common medium and many fine and very fine roots; few fine dark concretions (iron and manganese oxides); slightly acid; clear smooth boundary.

AB—26 to 31 inches; very dark grayish brown (10YR 3/2) clay loam (31 percent clay); many very dark brown (10YR 2/2) coatings on faces of peds; brown (10YR 4/3) faces of peds; moderate fine and medium subangular blocky structure; friable; few medium and many fine and very fine roots; few fine dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Bw1—31 to 37 inches; brown (10YR 4/3) clay loam (32 percent clay); common very dark brown (10YR 2/2) and dark brown (10YR 3/3) coatings on faces of peds; moderate fine prismatic structure parting to moderate fine subangular blocky; friable; few medium and many fine and very fine roots; common fine dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

Bw2—37 to 45 inches; brown (10YR 4/3) clay loam (31 percent clay); many dark brown (10YR 3/3) coatings on faces of peds; moderate medium prismatic structure parting to moderate medium subangular blocky; friable; many fine and very fine roots; common fine dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

Bw3—45 to 55 inches; brown (10YR 4/3) clay loam (31 percent clay); common dark brown (10YR 3/3) coatings on faces of peds; moderate medium and fine prismatic structure; friable; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

BC—55 to 60 inches; dark yellowish brown (10YR 4/4) clay loam (32 percent clay); brown (10YR 4/3) coatings on faces of peds; weak medium prismatic structure; friable; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); neutral.

The solum ranges from 40 to 60 inches or more in thickness. The mollic epipedon is 24 to 40 inches thick.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is loam or clay loam. The Bw horizon has value of 3 or 4 and chroma of 2 to 4. It is clay loam that has a clay content ranging from 28 to 34 percent.

Pershing Series

The Pershing series consists of moderately well drained and somewhat poorly drained, slowly permeable soils on convex ridgetops and convex side slopes on uplands. These soils formed in loess. Native vegetation was mixed prairie grasses and deciduous trees. Slopes range from 2 to 9 percent.

Typical pedon of Pershing silt loam, 2 to 5 percent slopes, in cropland; 1,320 feet south and 1,075 feet east of the northwest corner of sec. 14, T. 71 N., R. 24 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) silt loam (23 percent clay), grayish brown (10YR 5/2) dry; weak fine and very fine granular structure; friable; common medium and many fine and very fine roots; slightly acid; abrupt smooth boundary.

BE—7 to 12 inches; brown (10YR 5/3) silty clay loam (28 percent clay); common very dark grayish brown (10YR 3/2) organic coatings on faces of peds and in root channels; common faint yellowish brown (10YR 5/4) mottles; weak medium platy structure parting to weak very fine subangular blocky; friable; many light gray (10YR 7/2) dry silt coatings on faces of peds; few medium and many fine and very fine roots; few dark concretions (iron and manganese oxides); medium acid; clear smooth boundary.

Bt1—12 to 17 inches; yellowish brown (10YR 5/4) silty clay loam (36 percent clay); common fine distinct grayish brown (10YR 5/2) and common fine prominent strong brown (7.5YR 4/6) mottles; strong fine and very fine subangular blocky and angular blocky structure; firm; common distinct brown (10YR 4/3) clay films on faces of peds; common light gray (10YR 7/2) dry silt coatings on faces of peds; few medium and many fine and very fine roots; strongly acid; gradual smooth boundary.

Bt2—17 to 24 inches; dark grayish brown (10YR 4/2) silty clay (44 percent clay); brown (10YR 4/3) faces of peds; common fine prominent strong brown (7.5YR 4/6) and common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine prismatic structure parting to moderate fine and medium subangular blocky; very firm; many prominent dark gray (10YR 4/1) clay films on faces of peds; few medium and many fine and very fine roots; common fine dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

Bt3—24 to 30 inches; grayish brown (2.5Y 5/2) silty clay (44 percent clay); common fine and medium prominent brown (7.5YR 4/4) and strong brown (7.5YR 4/6) mottles; moderate medium prismatic structure parting to fine and medium subangular blocky; very firm; many distinct dark grayish brown (10YR 4/2) clay films on faces of peds; few medium and many fine and very fine roots; common fine dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

Bt4—30 to 38 inches; light brownish gray (2.5Y 6/2) silty clay (40 percent clay); brown (10YR 5/3) faces of peds; common fine prominent strong brown (7.5YR 5/6) and common fine distinct light olive brown (2.5Y 5/4) mottles; moderate medium prismatic structure parting to moderate medium and coarse subangular blocky; firm; common distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; common fine and very fine roots; many fine dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Bt5—38 to 45 inches; light brownish gray (2.5Y 6/2) silty clay loam (37 percent clay); common fine prominent strong brown (7.5YR 4/6) mottles; moderate medium prismatic structure; firm; common faint grayish brown (2.5Y 5/2) clay films on faces of peds; common fine and very fine roots; many fine and medium dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

BC—45 to 60 inches; light olive gray (5Y 6/2) silty clay loam (32 percent clay); many fine and medium prominent strong brown (7.5YR 4/6) and common fine distinct light olive brown (2.5Y 5/4) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; few faint grayish brown (2.5Y 5/2) clay films on faces of peds; few fine and very fine roots; many fine and medium dark concretions (iron and manganese oxides); slightly acid.

The solum ranges from 48 to more than 60 inches in thickness.

The A or Ap horizon is 6 to 9 inches thick, and has chroma of 1 or 2. It is silt loam or silty clay loam. Some pedons have an E horizon that has value of 4 or 5. The upper part of the Bt horizon has hue of 10YR or 2.5Y. The lower part of the Bt horizon and the BC horizon have hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 4. The maximum clay content in the Bt horizon ranges from 42 to 48 percent.

Sharpsburg Series

The Sharpsburg series consists of moderately well drained, moderately slowly permeable soils on narrow convex ridgetops and convex side slopes on uplands. These soils formed in loess. Native vegetation was tall prairie grasses. Slopes range from 2 to 9 percent.

Typical pedon of Sharpsburg silty clay loam, 2 to 5 percent slopes, in pasture; 825 feet south and 1,900 feet west of the northeast corner of sec. 7, T. 73 N., R. 27 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) silty clay loam (31 percent clay), dark grayish brown (10YR 4/2) dry; very dark grayish brown (10YR 3/2) worm casts on faces of peds; moderate fine and medium granular structure; friable; many fine and very fine roots; slightly acid; clear smooth boundary.

A1—9 to 14 inches; very dark brown (10YR 2/2) silty clay loam (34 percent clay), dark grayish brown (10YR 4/2) dry; very dark grayish brown (10YR 3/2) worm casts on faces of peds; weak fine and very fine subangular blocky structure parting to moderate fine granular; friable; many fine and very fine roots; medium acid; clear smooth boundary.

A2—14 to 19 inches; very dark grayish brown (10YR 3/2) silty clay loam (36 percent clay), dark grayish brown (10YR 4/2) dry; very dark brown (10YR 2/2) organic coatings on faces of peds and dark brown (10YR 3/3) worm casts on some faces of peds; weak fine and very fine subangular blocky structure parting to moderate fine and medium granular; friable; many fine and very fine roots; medium acid; clear smooth boundary.

Bt1—19 to 24 inches; brown (10YR 4/3) silty clay loam (37 percent clay); many very dark grayish brown (10YR 3/2) coatings on faces of peds and very dark brown (10YR 2/2) organic coatings in root channels; common fine distinct yellowish brown (10YR 5/4) mottles; moderate fine and very fine subangular blocky structure; friable; common distinct dark brown (10YR 3/3) clay films on faces of peds; many fine and very fine roots; few fine dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Bt2—24 to 29 inches; brown (10YR 4/3) silty clay loam (38 percent clay); common very dark grayish brown (10YR 3/2) organic coatings on faces of peds; common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine and very fine subangular blocky structure; firm; many distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

Bt3—29 to 34 inches; yellowish brown (10YR 5/4) silty clay loam (39 percent clay); few very dark grayish brown (10YR 3/2) organic coatings on faces of peds; common fine distinct grayish brown (2.5Y 5/2), strong brown (7.5YR 4/6), and yellowish brown (10YR 5/6) mottles; moderate fine and medium subangular blocky structure; firm; many distinct brown (10YR 4/3) clay films on faces of peds; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

Bt4—34 to 43 inches; grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/4) silty clay loam (37 percent clay); many fine distinct yellowish brown (10YR 5/6) and common fine prominent strong brown (7.5YR 4/6) mottles; moderate fine prismatic structure parting to moderate medium and fine subangular blocky; friable; common faint grayish brown (10YR 5/2) clay films on faces of peds; common fine and very fine roots; common fine dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

BC—43 to 51 inches; light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/4) silty clay loam (36 percent clay); many fine distinct yellowish brown (10YR 5/6) and common fine prominent strong brown (7.5YR 4/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; common faint grayish brown (10YR 5/2) clay films on faces of peds; few fine and very fine roots; common fine dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

C—51 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam (33 percent clay); many fine prominent strong brown (7.5YR 4/6) mottles; massive with vertical cleavage planes; friable; few fine and very fine roots; many fine dark concretions and stains (iron and manganese oxides); slightly acid.

The solum ranges from 48 to more than 60 inches in thickness. In uneroded areas the mollic epipedon is 16 to 24 inches thick.

The Ap horizon has chroma of 1 or 2. The A1 and A2 horizons have chroma of 2 or 3. The upper part of the

Bt horizon has value of 3 to 5 and chroma of 3 or 4. The lower part of the Bt horizon and the BC and C horizons have hue of 10YR to 5Y, value of 4 to 6, and chroma of 2 to 6.

The Sharpsburg soil in map unit 370C2 is a taxadjunct to the Sharpsburg series because this soil does not have a mollic epipedon, which is definitive for the Sharpsburg series.

Shelby Series

The Shelby series consists of moderately well drained, moderately slowly permeable soils on convex, valley side slopes on uplands. These soils formed in glacial till. Native vegetation was prairie grasses. Slopes range from 9 to 25 percent.

These soils are taxadjuncts to the Shelby series because they have a higher clay content in the argillic horizon than is defined for the Shelby series. The soils in map units 24D2, 24E2, 24E3, 24F2, 93D2, and 93D3 are also taxadjuncts to the Shelby series because they do not have a mollic epipedon, which is definitive for the Shelby series.

Typical pedon of Shelby loam, 18 to 25 percent slopes, in pasture; 1,980 feet north and 920 feet east of the southwest corner of sec. 1, T. 73 N., R. 27 W.

Ap—0 to 10 inches; very dark brown (10YR 2/2) loam (26 percent clay), dark grayish brown (10YR 4/2) dry; moderate fine and very fine granular structure; friable; few medium and many fine and very fine roots; slightly acid; clear smooth boundary.

AB—10 to 14 inches; very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) clay loam (34 percent clay), dark grayish brown (10YR 4/2) dry; common very dark brown (10YR 2/2) organic coatings on faces of peds; moderate fine subangular blocky structure; friable; many fine and very fine roots; dark yellowish brown (10YR 4/4) worm casts; about 3 percent fine pebbles; slightly acid; clear smooth boundary.

Bt1—14 to 17 inches; dark yellowish brown (10YR 4/4) clay loam (39 percent clay); common very dark brown (10YR 2/2) organic coatings on faces of peds and in root channels; common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine and very fine subangular blocky structure; firm; many distinct brown (10YR 4/3) clay films on faces of peds; many fine and very fine roots; about 4 percent pebbles; medium acid; clear smooth boundary.

Bt2—17 to 22 inches; dark yellowish brown (10YR 4/4) clay loam (39 percent clay); common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; firm; many distinct brown (10YR 4/3) clay films on faces of peds; many fine and very fine roots; few fine dark concretions and stains (iron and manganese oxides); about 5 percent pebbles; medium acid; gradual smooth boundary.

Bt3—22 to 30 inches; dark yellowish brown (10YR 4/4) clay loam (38 percent clay); common fine distinct yellowish brown (10YR 5/6), brown (7.5YR 4/4), and strong brown (7.5YR 4/6) mottles; moderate fine prismatic structure parting to moderate fine subangular and angular blocky; firm; many distinct brown (10YR 4/3) clay films on faces of peds; common fine and very fine roots; common fine dark concretions and stains (iron and manganese oxides); about 4 percent pebbles; strongly acid; gradual smooth boundary.

Bt4—30 to 40 inches; yellowish brown (10YR 5/4) clay loam (36 percent clay); common fine distinct grayish brown (2.5Y 5/2) and few fine distinct strong brown (7.5YR 4/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; common distinct brown (10YR 4/3) clay films on faces of peds; few fine and very fine roots; common fine dark concretions and stains (iron and manganese oxides); about 5 percent pebbles and stones; slightly acid; gradual smooth boundary.

Bt5—40 to 48 inches; yellowish brown (10YR 5/4) clay loam (32 percent clay); common fine distinct grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; common faint brown (10YR 5/3) clay films on faces of peds; few fine and very fine roots; common fine dark concretions and stains (iron and manganese oxides); about 5 percent pebbles and stones; slightly effervescent; mildly alkaline; gradual smooth boundary.

BC—48 to 56 inches; yellowish brown (10YR 5/6) clay loam (32 percent clay); common medium prominent light brownish gray (2.5Y 6/2) mottles; weak medium prismatic structure; firm; common faint brown (7.5YR 4/4) clay films on faces of prisms; few fine roots; common fine dark concretions and stains (iron and manganese oxides); common white soft thread-like and hard carbonate nodules; about 4 percent pebbles; strongly effervescent; mildly alkaline; gradual smooth boundary.

C—56 to 60 inches; mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/4) clay loam (32 percent clay); massive; firm; common medium dark concretions and stains (iron and manganese oxides); common soft to very hard carbonate nodules less than 1/4 inch in diameter; about 5 percent pebbles and stones; strongly effervescent; mildly alkaline.

The solum ranges from 45 to 60 inches in thickness. The soil commonly is calcareous below a depth of 40 inches. In uneroded soils the mollic epipedon is 10 to 16 inches thick.

The A or Ap horizon has value of 2 or 3 and chroma of 1 or 2. An AB or BA horizon has value and chroma of 2 or 3. Some pedons do not have an AB or BA horizon. The Bt horizon has chroma of 3 to 6. It is clay loam, and averages between 35 and 38 percent clay.

Vesser Series

The Vesser series consists of poorly drained, moderately permeable soils on the higher bottom land, foot slopes, and alluvial fans. These soils formed in silty alluvium. Native vegetation was tall prairie grasses. Slopes range from 0 to 5 percent.

Typical pedon of Vesser silt loam, 0 to 2 percent slopes, in pasture; 1,715 feet south and 925 feet east of the northwest corner of sec. 2, T. 71 N., R. 24 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silt loam (23 percent clay), dark gray (10YR 4/1) dry; moderate fine and very fine granular structure; friable; common medium and many fine and very fine roots; slightly acid; clear smooth boundary.

A—9 to 13 inches; very dark gray (10YR 3/1) silt loam (23 percent clay), dark gray (10YR 4/1) dry; common very dark grayish brown (10YR 3/2) coatings on faces of peds; few fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure parting to moderate fine granular; friable; common medium and many fine and very fine roots; medium acid; clear smooth boundary.

E1—13 to 17 inches; dark gray (10YR 4/1) and very dark gray (10YR 3/1) silt loam (20 percent clay), light gray (10YR 6/1) dry; common very dark grayish brown (10YR 3/2) coatings on faces of peds; few fine distinct brown (7.5YR 4/4) mottles; moderate medium and thick platy structure; friable; common medium and many fine and very fine roots; common fine dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

E2—17 to 22 inches; dark gray (10YR 4/1) silt loam (18 percent clay), light gray (10YR 6/1) dry; common very dark gray (10YR 3/1) organic coatings on faces of peds; common fine distinct brown (7.5YR 4/4) mottles; moderate medium and thick platy structure; friable; many light gray (10YR 7/2) dry silt coatings on faces of peds; few medium and many fine and very fine roots; common fine dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

E3—22 to 28 inches; dark gray (10YR 4/1) and gray (10YR 5/1) silt loam (18 percent clay), light gray (10YR 6/1) dry; common fine distinct brown (7.5YR 4/4) mottles; moderate medium platy structure; friable; many light gray (10YR 7/1) dry silt coatings on faces of peds; few medium and many fine and very fine roots; common fine and medium dark concretions (iron and manganese oxides); strongly acid; clear smooth boundary.

E4—28 to 32 inches; dark gray (10YR 4/1) silt loam (18 percent clay); common fine distinct strong brown (7.5YR 4/6) and brown (7.5YR 4/4) mottles; moderate thick platy structure parting to weak fine and medium subangular blocky; friable; many light gray (10YR 7/1) dry silt coatings on faces of peds; few medium and many fine and very fine roots; common fine and medium dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

Btg1—32 to 36 inches; dark gray (10YR 4/1) silty clay loam (30 percent clay); common very dark gray (10YR 3/1) organic coatings on faces of peds; common fine distinct strong brown (7.5YR 4/6) and brown (7.5YR 4/4) mottles; moderate fine prismatic structure parting to moderate fine and medium subangular blocky; friable; many distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; common light gray (10YR 7/1) dry silt coatings on faces of peds; few medium and many fine and very fine roots; common fine and medium dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Btg2—36 to 43 inches; dark gray (10YR 4/1) silty clay loam (39 percent clay); common very dark gray (10YR 3/1) organic coatings on faces of peds; common fine distinct strong brown (7.5YR 4/6) mottles; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; firm; many distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; few medium and many fine and very fine roots; common fine and medium dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Btg3—43 to 60 inches; very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) silty clay loam (35 percent clay); common fine distinct strong brown (7.5YR 4/6) and brown (7.5YR 4/4) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; common distinct dark gray (10YR 4/1) clay films on faces of peds; common fine and very fine roots; common fine and medium dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

The solum typically is more than 60 inches in thickness. The mollic epipedon ranges from 10 to 14 inches in thickness.

The Ap or A horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has value of 3 to 5 and chroma of 1 or 2. The Btg horizon has hue of 10YR or 2.5Y and value of 3 to 5. The average content of clay in the upper 20 inches of this horizon is 30 to 35 percent, but some pedons have thin horizons that have 35 to 40 percent clay.

Weller Series

The Weller series consists of moderately well drained, slowly permeable soils on convex ridgetops and upper side slopes on uplands. These soils formed in loess. Native vegetation was deciduous trees. Slopes range from 5 to 9 percent.

Typical pedon of Weller silt loam, 5 to 9 percent slopes, in woodland; 1,075 feet south and 1,570 feet east of the northwest corner of sec. 12, T. 71 N., R. 24 W.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) silt loam (22 percent clay), light brownish gray (10YR 6/2) dry; weak fine and very fine granular structure; friable; common medium and many fine and very fine and few coarse roots; slightly acid; abrupt smooth boundary.

E1—3 to 6 inches; dark grayish brown (10YR 4/2) silt loam (22 percent clay), light brownish gray (10YR 6/2) dry; common very dark grayish brown (10YR 3/2) organic coatings on faces of peds; moderate medium platy structure; friable; common medium and many fine and very fine and few medium and coarse roots; few fine dark concretions (iron and manganese oxides); slightly acid; clear smooth boundary.

E2—6 to 9 inches; brown (10YR 4/3) silt loam (21 percent clay), pale brown (10YR 6/3) dry; moderate medium and thin platy structure; friable; many very pale brown (10YR 7/3) dry silt coatings on faces of peds; common medium and many fine and very fine and few coarse roots; few fine dark concretions (iron and manganese oxides); strongly acid; abrupt smooth boundary.

BE—9 to 13 inches; yellowish brown (10YR 5/4) silt loam (26 percent clay); common faint dark yellowish brown (10YR 4/4) mottles; weak fine and medium subangular blocky structure; friable; common distinct brown (10YR 4/3) clay films on faces of peds; common light brownish gray (10YR 6/2) dry silt coatings on faces of peds; common medium and many fine and very fine and few coarse roots; few fine dark concretions (iron and manganese oxides); very strongly acid; clear smooth boundary.

Bt1—13 to 19 inches; yellowish brown (10YR 5/4) silty clay loam (34 percent clay); common fine distinct yellowish brown (10YR 5/6) mottles; strong fine and medium subangular and angular blocky structure; friable; common distinct brown (10YR 4/3) clay films on faces of peds; common light brownish gray (10YR 6/2) dry silt coatings on faces of peds; common medium and many fine and very fine roots; common fine dark concretions (iron and manganese oxides); very strongly acid; clear smooth boundary.

Bt2—19 to 28 inches; yellowish brown (10YR 5/4) silty clay (48 percent clay); common fine prominent strong brown (7.5YR 4/6) and common fine faint grayish brown (10YR 5/2) mottles; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; very firm; many distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; common medium and many fine and very fine roots; common fine dark concretions (iron and manganese oxides); very strongly acid; gradual smooth boundary.

Bt3—28 to 39 inches; brown (10YR 5/3) silty clay (43 percent clay); many fine prominent strong brown (7.5YR 4/6) and grayish brown (2.5Y 5/2) and few fine prominent yellowish red (5YR 4/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; common fine distinct grayish brown (10YR 5/2) clay films on faces of peds; few medium and many fine and very fine roots; common fine dark concretions (iron and manganese oxides); very strongly acid; gradual smooth boundary.

Bt4—39 to 50 inches; grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/4) silty clay loam (35 percent clay); common fine and medium prominent strong brown (7.5YR 4/6) mottles; moderate medium and fine prismatic structure parting to weak medium subangular blocky; friable; common distinct grayish brown (10YR 5/2) clay films on faces of peds; few medium and common fine and very fine roots; common fine and medium dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

BC—50 to 60 inches; light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/4) silty clay loam (31 percent clay); common fine prominent strong brown (7.5YR 4/6) and brown (7.5YR 4/4) mottles; weak medium prismatic structure; friable; common faint grayish brown (2.5Y 5/2) clay films on faces of peds; common fine and very fine roots; many fine dark concretions (iron and manganese oxides); strongly acid.

The solum ranges from 48 to more than 60 inches in thickness.

The A horizon has chroma of 1 or 2. It is 3 to 5 inches thick. The Ap horizon has value of 4 or 5 and chroma of 2 or 3. In areas where it has been mixed with the B horizon, the Ap horizon is silty clay loam. Some pedons do not have an Ap horizon. The E horizon has value of 4 or 5. The upper part of the Bt horizon has value of 4 or 5 and chroma of 3 or 4. The lower part of the Bt horizon and the BC horizon have hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. The maximum clay content in the Bt horizon ranges from 42 to 48 percent.

Winterset Series

The Winterset series consists of poorly drained, moderately slowly permeable soils on broad upland divides. These soils formed in loess. Native vegetation was tall prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Winterset silty clay loam, 0 to 2 percent slopes, in cropland; 2,630 feet north and 100 feet east of the southwest corner of sec. 6, T. 73 N., R. 25 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam (33 percent clay), dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to moderate fine and very fine granular; friable; common fine and very fine and few medium roots; neutral; clear smooth boundary.

A1—8 to 15 inches; black (10YR 2/1) silty clay loam (35 percent clay), dark gray (10YR 4/1) dry; moderate fine subangular blocky structure parting to moderate fine and very fine granular; friable; many fine and very fine and few medium roots; slightly acid; clear smooth boundary.

A2—15 to 19 inches; black (10YR 2/1) silty clay loam (36 percent clay), dark gray (10YR 4/1) dry; common fine distinct dark grayish brown (10YR 4/2) mottles; moderate fine and very fine subangular blocky structure; friable; many fine and very fine roots; medium acid; gradual smooth boundary.

Bt—19 to 22 inches; very dark gray (10YR 3/1) silty clay (42 percent clay), gray (10YR 5/1) dry; common fine distinct yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) mottles; moderate fine and very fine subangular blocky structure; firm; common distinct black (10YR 2/1) clay films on faces of peds; common fine and very fine roots; few fine dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Btg1—22 to 27 inches; dark grayish brown (10YR 4/2) silty clay (43 percent clay); common very dark gray (10YR 3/1) coatings on faces of peds; common fine faint grayish brown (2.5Y 5/2) and dark yellowish brown (10YR 4/4) and common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine and medium subangular blocky structure; firm; common distinct dark gray (10YR 4/1) clay films on faces of peds; common fine and very fine roots; few fine concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Btg2—27 to 32 inches; grayish brown (2.5Y 5/2) silty clay (40 percent clay); common fine distinct light olive brown (2.5Y 5/4) mottles; moderate fine prismatic structure parting to moderate fine and medium subangular blocky; firm; many distinct dark grayish brown (10YR 4/2) clay films on faces of peds; few fine and very fine roots; few fine dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Btg3—32 to 40 inches; grayish brown (10YR 5/2) silty clay loam (39 percent clay); common fine and medium distinct light olive brown (2.5Y 5/6) and common fine prominent strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; common distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds and dark gray (10YR 4/1) clay films lining root channels; few fine and very fine roots; common fine dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Btg4—40 to 50 inches; olive gray (5Y 5/2) silty clay loam (36 percent clay); common fine and medium distinct light olive brown (2.5Y 5/6) and few fine prominent yellowish red (5YR 4/6) mottles; moderate medium prismatic structure; friable; common distinct dark gray (5Y 4/1) clay films on faces of peds; few fine and very fine roots; common fine dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

Cg—50 to 60 inches; light olive gray (5Y 6/2) silty clay loam (33 percent clay); common fine and medium distinct light olive brown (2.5Y 5/6) and few fine prominent yellowish red (5YR 5/6) mottles; massive with distinct vertical cleavage planes; friable; few fine and very fine roots; common fine dark concretions (iron and manganese oxides); neutral.

The solum ranges from 48 to more than 60 inches in thickness. Carbonates are not in the solum. The mollic epipedon is 10 to more than 22 inches thick.

The A horizon is neutral (N) or has hue of 10YR and chroma of 0 or 1. The Bt horizon has hue of 10YR to 5Y, value of 3 to 5, and chroma of 1 or 2. The clay content of the control section is between 38 and 42 percent. The C horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 or 2.

Zook Series

The Zook series consists of poorly drained, slowly permeable soils on bottom land and in upland drainageways. These soils formed in alluvium. Native vegetation was swamp grasses, sedges, and prairie grasses tolerant of wetness. Slopes range from 0 to 2 percent.

Typical pedon of Zook silty clay loam, 0 to 2 percent slopes, in cropland; 1,800 feet north and 100 feet west of the southeast corner of sec. 10, T. 71 N., R. 25 W.

Ap—0 to 10 inches; black (10YR 2/1) silty clay loam (32 percent clay), dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to moderate fine granular; friable; common fine and very fine roots; neutral; clear smooth boundary.

A1—10 to 15 inches; black (N 2/0) silty clay loam (33 percent clay), very dark gray (10YR 3/1) dry; moderate fine and very fine subangular blocky structure parting to moderate fine granular; friable; common fine and very fine roots; slightly acid; clear smooth boundary.

A2—15 to 19 inches; black (N 2/0) silty clay loam (38 percent clay), very dark gray (10YR 3/1) dry; moderate fine and very fine subangular blocky structure; firm; sheen on moist faces of peds; common fine and very fine roots; slightly acid; clear smooth boundary.

A3—19 to 36 inches; black (N 2/0 and 10YR 2/1) silty clay (45 percent clay), very dark gray (10YR 3/1) dry; moderate fine and medium prismatic structure parting to moderate fine and medium subangular blocky; firm; sheen on moist faces of peds; few fine and very fine roots; few fine dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Bg1—36 to 48 inches; very dark gray (10YR 3/1) and dark gray (10YR 4/1) silty clay (47 percent clay); common black (10YR 2/1) coatings on faces of peds; weak medium prismatic structure parting to moderate medium subangular blocky; very firm; few fine and very fine roots; few fine dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Bg2—48 to 58 inches; dark gray (10YR 4/1) silty clay (44 percent clay); few black (10YR 2/1) coatings on faces of peds; weak medium prismatic structure parting to weak medium subangular blocky; firm; few fine roots; few fine concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

Cg—58 to 60 inches; dark gray (5Y 4/1) silty clay (43 percent clay); massive with some vertical cleavage planes; firm; few fine roots; common fine dark concretions (iron and manganese oxides); slightly acid.

The solum ranges from 36 to 60 inches in thickness. The mollic epipedon is 30 to 50 inches thick.

The A horizon has hue of 10YR or is neutral (N). It has chroma of 0 or 1. It is 30 to 48 inches thick. Some places have 6 to 10 inches of silt loam overwash. The Bg and Cg horizons have hue of 10YR to 5Y and value of 3 to 5. The clay content of the control section is 38 to 45 percent.

Formation of the Soils

The factors of soil formation and their effect on the soils in Clarke County are described in this section. The processes of soil formation that result in the formation of soil horizons are also described. Detailed descriptions of profiles typical of the series are given in the section "Soil Series and Their Morphology."

Factors of Soil Formation

Soil forms through processes that act on deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material, the climate under which the soil material has accumulated and existed since accumulation, the plant and animal life on and in the soil, the relief, and the length of time that the forces of soil formation have acted on the soil material *(5)*. Human activities also affect soil formation.

Climate and vegetation are the active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks, and slowly change it into a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil. Some time is always needed for horizon differentiation. A long period generally is needed for the formation of distinct horizons. The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the others.

Parent Material

The accumulation of parent material is the first step in the formation of a soil. All soils in Clarke County formed in material that was transported from the site of the parent rock and redeposited at a new location through the action of glacial ice, water, wind, and gravity. The principal parent materials in Clarke County are glacial till, loess, and alluvium. The various geologic depositions and subsequent erosion by streams have resulted in the formation of moderately broad, nearly level and gently sloping ridgetops. The soils formed in loess are on these ridgetops. The moderately sloping to very steep soils on side slopes formed in loess and glacial till. The soils on bottom land along streams formed in alluvium.

Glacial till is unsorted, nonstratified, glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glacial till is the most extensive parent material, and covers about 52 percent of the surface area in the county. It is exposed in all parts of the county and, on steep slopes, forms a major part of the landscape. The unweathered till is a firm, calcareous clay loam. It contains pebbles, boulders, and sand, as well as silt and clay. The till is a heterogeneous mixture, and shows little evidence of sorting or stratification. The mineral composition of its components is also heterogeneous, and is similar to that of particles in unweathered loess. The glacial till ranges from 0 to more than 300 feet in thickness.

At least two major glaciations during the Pleistocene Epoch affected Clarke County. The Nebraskan Glaciation occurred about 750,000 years ago *(6, 14)*. It was followed by the Aftonian interglacial period. The Kansan Glaciation occurred about 500,000 years ago. It was followed by the combined Yarmouth and Sangamon interglacial periods. As the glaciers retreated they left behind a vast deposit of glacial till.

Nebraskan till is in a few places of the county. Kansan till is exposed on steeper slopes in all parts of the county, and forms an extensive part of the landscape.

The Aftonian paleosol formed on the Nebraskan till plain during the Aftonian interglacial period before the Kansan Glaciation. It is strongly weathered, gray clay and very slowly permeable. It is a few to several feet in thickness. Observations made during the survey show that small areas of the Aftonian paleosol are exposed in some parts of the county. These areas are not large enough to be delineated separately, and are shown on the soil maps by spot symbols for gray clay.

Soil formed on the Kansan till plain during the combined Yarmouth and Sangamon interglacial periods before the loess was deposited *(12)*. In nearly level areas the soils were strongly weathered, and have a thick, gray, plastic, clayey subsoil called "gumbotil." These soils are also called paleosols, or "ancient soils" *(10, 13)*. This Yarmouth-Sangamon paleosol (gumbotil) is several feet thick and very slowly permeable. The Clarinda soils formed in this paleosol. They are extensive throughout Clarke County. The Bucknell and Lamoni soils formed in the truncated Yarmouth-Sangamon paleosol. The clayey layer in these soils is not as thick as that in the Clarinda soils. The Lamoni soils are extensive throughout Clarke County.

Late in the Sangamon interglacial period, geologic erosion cut through the Yarmouth-Sangamon paleosol and into the Kansan till. At the depth to which this erosion has cut, generally a stone line or subjacent till is overlain by pedisediment *(9, 10, 11)*. A paleosol formed in this material. Geologic erosion removed the loess from many slopes and left the paleosol exposed on the surface. The late Sangamon paleosol generally is reddish in color, and is thinner than the Yarmouth-Sangamon paleosol. The Adair, Armstrong, and Keswick soils formed in the late Sangamon paleosol.

The Caleb and Mystic soils formed in pre-Sangamon sediments of valley fills. These sediments are of glacial origin and vary in texture *(10)*. They are on low-stepped interfluves above the present valley floor. They are on a landscape that is partly valley fill, but their surface merges with the present erosional uplands. The Caleb and Mystic soils are above the flood plain, but they are lower than the Gara, Lindley, and Shelby soils, which formed in Kansan till on dissected slopes of late Wisconsinan age. The Gara, Lindley, and Shelby soils are extensive in Clarke County.

Loess, a silty material deposited by wind, covers about 32 percent of the county. It was deposited during the Wisconsinan glacial period between 29,000 to 14,000 years ago *(3)*. It consists mostly of silt and some clay. It also contains small amounts, generally less than 5 percent, of fine sand and very fine sand. The major source of loess in Clarke County was probably the flood plains of the Missouri River and its tributaries in the western part of Iowa. The thickness of loess and the content of clay in loess are related to the distance from the source of loess.

In Clarke County, the thickness of loess ranges from 8 to 12 feet on the stable upland divides. It is thinner on side slopes and narrow, low interfluves. Loess is slightly thicker in the northwestern part of the county, where the Clearfield, Ladoga, Macksburg, Nira, Sharpsburg, and Winterset soils formed. It is also in the rest of the county, where the Arispe, Edina, Grundy, Haig, Pershing, and Weller soils formed. The Lineville soils formed in 10 to 20 inches of loess over glacial sediments underlain by a late Sangamon paleosol weathered from glacial till.

Alluvium is sediment deposited by water along major and minor streams and drainageways. It is also on low stream terraces. The texture of alluvium varies widely because of the source of material and the manner in which it was deposited. Loess and glacial till are the main sources of alluvium in Clarke County.

Colluvium is sediment deposited on or at the base of steep slopes by mass wasting and local, unconcentrated runoff. It retains many characteristics of soils on the slopes from which it is eroded. The Cantril and Olmitz soils formed in colluvium on foot slopes of till-derived soils.

Alluvial sediment is the parent material of soils on flood plains, terraces, and drainageways. As the streams overflow their channels, they deposit alluvium. The coarser or larger particles are deposited closer to the stream channel or in and along the main path of floodwater. The finer particles are deposited in areas farther away from the stream channel, where the floodwater moves slowly or is still. The Ackmore, Colo, Lawson, Nodaway, and Zook soils formed in silty alluvium. The major areas where these soils formed in alluvium are on bottom land of South River, Squaw Creek, Whitebreast Creek, and Long Creek. The Humeston and Vesser soils are on low stream terraces, are less subject to overflow, and have more profile development.

Climate

The soils in Clarke County formed under the influence of a midcontinental climate for at least 3,000 years *(10)*. The morphology and properties of most of the soils indicate that this climate was similar to the present climate. Between 30,000 and 11,000 years ago, the climate was cooler and moist, and favored the growth of coniferous forest vegetation. As the climate warmed, deciduous forest invaded and persisted until about 9,000 years ago. Since that time, the climate has been characterized by further warming and greater dryness. Under these climatic conditions, the dominant vegetation has been mixed prairie grasses and deciduous forest.

The general climate has had an important overall influence on the characteristics of soils, but has not caused major differences among them. The influence of general climate in a region is modified by local conditions. For example, the soils on south-facing slopes formed under a microclimate that is warmer and drier than that of soils in nearby areas. Also, the low-lying, poorly drained soils on bottom land formed under a microclimate that is wetter and colder than that of most of the surrounding soils. Local conditions account for some of the differences among soils in the county.

Changes in temperature activate the weathering of parent material by water and air. As the parent material weathers, changes caused by physical and chemical actions take place. Rainfall affects the amount of leaching in the soil and the kinds of plants on the soil. Temperature and other climatic factors indirectly affect soil formation through their effect on plant and animal life on and in the soil.

Plant and Animal Life

Plant and animal life have an important effect on the formation of soils. Plant life is especially significant, for it helps to initiate soil formation. Different kinds of plant life have a marked influence on the differences among soils.

The soils of Clarke County appear to have been influenced in recent times by two main kinds of plant life, prairie grasses and deciduous trees. The main prairie grasses were big bluestem, little bluestem, and Indian grass. The trees were mainly oak, hickory, ash, elm, maple, and other deciduous trees.

The native grasses, which have many roots and tops, have decayed in or on the soil. In this way they have added large amounts of organic matter to the surface layer of some soils. As a result, these soils have a thicker dark colored surface layer than soils formed under trees. Trees commonly add little organic matter, mainly fallen leaves and dead branches or trunks, to the surface layer. Soils formed under trees have a thin A horizon, a gray E horizon that is very distinct when dry, and a B horizon that has a stronger structure and more accumulated silicate clay than that in prairie soils.

The soils that formed under mixed grasses and trees have properties of both soils formed only under grasses and those formed only under trees.

The Grundy, Haig, and Shelby soils are typical of soils formed under prairie grasses. The Weller and Lindley soils are typical of soils formed under trees *(8)*. The Gara and Pershing soils are typical of soils formed under mixed grasses and trees, and have properties intermediate between those of soils formed only under grasses and those formed only under trees.

The Grundy, Pershing, and Weller soils are members of a biosequence. They are a group of soils formed in the same parent material and under a similar climate, but that have supported different kinds of native vegetation. The Grundy soils formed under prairie grasses, the Pershing soils under mixed grasses and trees, and the Weller soils under trees. The main morphological differences among the three soils are the result of the different kinds of native vegetation.

The activities of burrowing animals and insects tend to loosen and aerate the upper few feet of soil.

Relief

Relief affects the formation of soils mainly through its effect on drainage, runoff, depth to the water table, and potential erosion. The soils in Clarke County range from nearly level to very steep. Nearly level soils are on moderately wide ridgetops and flood plains. The steepest soils are along the major streams and their tributaries. The intricate pattern of upland drainageways indicates that in nearly all of the county, the landscape has been modified by geologic processes.

A difference in slope is the main reason for the differing properties among some of the soils formed in the same parent material and under similar climate. Slope affects erosion and the amount of water that runs off and percolates through the soil. Erosion and runoff cause differences in the thickness and color of the A horizon, the thickness of the solum, increased clay in the subsoil, and depth to the maximum clay zone. A comparison of the Arispe and Haig soils illustrates this effect of relief on the soils.

Natural drainage affects the color of the subsoil. For example, in the poorly drained Haig and Winterset soils, the subsoil is dominantly grayish and mottled. These soils have a seasonal high water table at a depth of 1 to 2 feet. In the moderately well drained Sharpsburg soils, the subsoil is dominantly brown. These Sharpsburg soils have a seasonal high water table below a depth of 6 feet. The Grundy and Macksburg soils are somewhat poorly drained, and are grayish brown in the subsoil.

Aspect and topographic position, as well as gradient, have a significant effect on soil formation. South-facing slopes, for example, generally are warmer and drier than north-facing slopes. Consequently, they support a different kind and amount of vegetation and differ in organic matter content in the surface layer.

The Gara, Lindley, and Shelby soils are on a wide range of slopes and landscapes. In these soils depth to carbonates is less as the percent of slope increases and slopes become more convex and shorter.

Slope affects runoff, which in turn affects the amount of moisture available to plants. The lack of moisture restricts the growth of some types of vegetation and may result in a lower content of organic matter.

Time

The length of time that the soil material is acted on by soil-forming processes affects the kind of soil that forms. The older soils have strongly expressed genetic horizons. The younger soils have only weakly expressed horizons. Some soils on flood plains show little or no evidence of soil formation because they have not been in place long enough for distinct horizons to develop. The Nodaway soils are an example.

An older soil generally has a higher content of clay in the subsoil than a younger soil forming in a similar parent material. As a soil forms, clay is moved from the surface layer to the subsoil. This transfer increases the content of clay in the subsoil. It is more evident in nearly level soils than in more sloping soils.

In steeper areas, the soil material is generally removed before enough time has passed for the development of a thick profile that has strong horizons. Even if the soil material has been in place a long time, the soil still exhibits little development because much of the water runs off the slopes rather than through the soil material. The Gara, Lindley, and Shelby soils formed in recently dissected slopes of late Wisconsinan age *(10, 11)*.

Human Activities

Since Clarke County was settled, breaking the prairie sod and clearing the timber have removed or changed the protective cover on the soil.

Water erosion has caused the most apparent changes to the soil. As the land was cultivated, the rate at which water moved into the soil decreased and surface runoff increased. This increased runoff has resulted in accelerated erosion, which has removed part or all of the original surface layer from much of the cultivated sloping land. In some places shallow to deep gullies have formed.

Erosion has not only thinned the surface layer, but also changed the structure and consistence. In most severely eroded areas, the plow layer is a mixture of the original surface layer and material from the upper part of the subsoil, which is less friable and finer textured than the surface layer.

Erosion and cultivation also affect the soil by reducing the organic matter content and lowering the fertility. Even in areas that are not subject to erosion, heavy machinery has compacted the surface layer and changed its structure. The granular structure that is so apparent in virgin grassland breaks down under intensive cropping.

Man, however, can do and has done much to increase soil productivity, decrease soil loss, and reclaim areas not suited to crops or pasture. Terraces, water-and-sediment control basins, and other erosion-control practices in some places have been installed to reduce runoff and control erosion. Diversions at the base of slopes and drainage ditches have helped prevent flooding and deposition, and have allowed cultivation of large areas of bottom land. Deficiencies in plant nutrients have been corrected through the use of commercial fertilizers and lime. Consequently, many soils are more productive now than in their natural state.

Erosion is the main cause of a decrease in the content of organic matter in soils. Erosion-control measures cannot increase the content of organic matter to the level characteristic of native grassland. These measures, however, keep the content at a level needed for cultivated crops.

Processes of Soil Formation

Horizon differentiation is the result of additions, removals, transfers, and transformations *(14)*. Each of these processes affects many substances in the soils, such as organic matter, soluble salts, carbonates, sesquioxides, and silicate clay minerals. The changes brought about by these processes help to determine the ultimate nature of the soil profile.

The accumulation of organic matter generally is an early phase of horizon differentiation. This accumulation has been an important process in the differentiation of horizons in the soils of Clarke County. The content of organic matter ranges from very high to very low in the A horizon of the soils in Clarke County. It is low in the thin A horizon of Weller and Lindley soils. It is high in the thick A horizon of Colo and Zook soils. In some soils it is low because erosion has removed part of the A horizon.

The removal of substances from parts of the soil profile is important in the differentiation of horizons. The downward movement of calcium carbonate and bases is an example. Free carbonates have been leached from the upper part of nearly all of the soils. Some soils are so strongly leached that they are strongly acid or very strongly acid in the subsoil.

A number of substances are transferred from one horizon to another in the soils of the county. Phosphorus, for example, is removed from the subsoil by plant roots and is transferred to the parts of plants growing above the ground. Then, as plant residue, phosphorus is added to the surface layer. This process affects the form and distribution of phosphorus in the profile.

The translocation of silicate clay minerals has an important effect on horizon differentiation. The clay minerals are carried downward in suspension by percolating water from the A horizon. They accumulate in the B horizon as fillings in pores and root channels and as clay films on faces of peds. This process has affected many soils in the county. In a few soils the clay content of the A horizon is not markedly different from that of the B horizon and other evidence of clay movement is minimal.

Cracks that form when soils shrink and swell is a kind of transfer that occurs only in the very clayey soils. As a result, some of the material from the surface layer is transferred to the lower parts of the profile. The Clarinda soils, for example, shrink and swell.

Transformations are both physical and chemical. The weathering of soil particles to smaller sizes is an example of a physical transformation. The reduction of iron is an example of a chemical transformation. This process is called gleying, and occurs when the soil is saturated for long periods. The soil contains enough organic matter for biological activity to take place during the period of saturation. Gleying is evidenced by ferrous iron and gray colors in the soil. It is characteristic of poorly drained soils, such as the Haig soils. The content of reductive extractable iron, or free iron, generally is lower in the somewhat poorly drained soils, such as the Grundy soils.

Another kind of transformation occurs in primary apatite, which is present in soil parent materials. This mineral weathers to secondary phosphorus compounds.

References

(1) American Association of State Highway and Transportation Officials. 1982. Standard specifications for highway materials and methods of sampling and testing. Ed. 13, 2 vols., illus.

(2) American Society for Testing and Materials. 1985. Standard test method for classification of soils for engineering purposes. ASTM Stand. D 2487.

(3) Hutton, Curtis E. 1947. Studies of loess-derived soils in southwestern Iowa. Soil Sci. Soc. Am. Proc. 12: 424-431, illus.

(4) Iowa Department of Agriculture. 1986. Iowa agricultural statistics. 133 pp., illus.

(5) Jenny, Hans. 1941. Factors of soil formation. McGraw-Hill Book Company, Inc., 281 pp., illus.

(6) Kay, George F., and Jack B. Graham. 1943. The Illinoian and post-Illinoian Pleistocene geology of Iowa. Iowa Geol. Surv. Annu. Rep. 38, 262 pp., illus.

(7) Lewis Publishing Company. 1886. Biographical and historical record of Clarke County, Iowa. 531 pp., illus.

(8) Prill, R.C., and F.F. Riecken. 1958. Variations in forest-derived soils formed in Kansan till in southern and southeastern Iowa. Soil Sci. Soc. Am. Proc. 22: 70-75, illus.

(9) Ruhe, Robert V. 1956. Ages and development of soil landscapes in relation to climatic and vegetational changes in Iowa. Soil Sci. Soc. Am. Proc. 20: 264-273, illus.

(10) Ruhe, Robert V. 1956. Geomorphic surfaces and the nature of soils. Soil Sci. 82: 441-445, illus.

(11) Ruhe, Robert V. 1959. Stone lines in soils. Soil Sci. 87: 223-231, illus.

(12) Ruhe, Robert V. 1968. Identification of paleosols in loess deposits in the United States. Proc. VII Congr. Int. Assoc. Quaternary Res. 12: 49-65.

(13) Ruhe, Robert V., and R.B. Daniels. 1958. Soils, paleosols, and soil-horizon nomenclature. Soil Sci. Soc. Am. Proc. 22: 66-69, illus.

(14) Simonson, Roy W. 1959. Outline of a generalized theory of soil genesis. Soil Sci. Soc. Am. Proc. 23: 152-156, illus.

(15) United States Department of Agriculture. 1928. Soil survey of Clarke County, Iowa. Bur. of Chem. and Soils, 124 pp., illus.

(16) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus.

(17) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

Glossary

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.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

Bedding system. A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

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.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

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.

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.

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Gumbotil. A leached, deoxidized clay containing siliceous stones. The product of thorough chemical weathering of clay-rich glacial till.

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.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

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.

Paleosol. A buried soil or formerly buried soil, especially one that formed during an interglacial period and was covered by deposits of later glaciers.

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 erosional surface and has been transported to its present position from higher lying areas of the erosional 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.

Planosolic soil. A soil with eluviated surface and subsurface horizons underlain by B horizons that are more strongly illuviated or compacted than the associated soils.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are—

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

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.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

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.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then 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 refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the 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.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Water table (seasonal high). The highest level of a saturated zone in the soil in most years.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-84 at Osceola, Iowa)

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-----	30.2	10.7	20.5	58	6	0	0.99	0.29	1.54	4	7.6
February----	36.4	16.6	26.5	64	6	7	1.12	.46	1.68	3	6.9
March-------	47.2	26.2	36.7	79	6	34	2.36	.93	3.56	6	6.9
April-------	63.1	39.9	51.5	87	18	130	3.43	2.16	4.57	7	1.5
May---------	73.8	50.5	62.2	90	30	387	4.42	2.54	6.09	8	.0
June--------	82.5	59.5	71.0	97	44	630	4.75	2.57	6.66	8	.0
July--------	87.0	63.8	75.4	100	49	787	4.10	1.45	6.30	6	.0
August------	85.0	61.3	73.2	98	46	719	3.79	1.54	5.67	7	.0
September---	77.2	52.9	65.1	94	35	453	4.01	1.60	6.02	6	.0
October-----	66.5	42.4	54.5	88	20	210	2.73	.90	4.26	5	.3
November----	49.6	29.0	39.3	74	3	15	1.97	.55	3.12	4	1.9
December----	36.0	17.7	26.9	63	3	0	1.19	.41	1.82	3	6.0
Yearly:											
Average---	61.2	39.2	50.2	---	---	---	---	---	---	---	---
Extreme---	---	---	---	101	3	---	---	---	---	---	---
Total-----	---	---	---	---	---	3,372	34.86	29.10	41.12	67	31.1

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1951-84 at Osceola, Iowa)

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 18	Apr. 26	May 7
2 years in 10 later than--	Apr. 14	Apr. 22	May 3
5 years in 10 later than--	Apr. 5	Apr. 13	Apr. 24
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 16	Oct. 6	Sept. 28
2 years in 10 earlier than--	Oct. 21	Oct. 12	Oct. 3
5 years in 10 earlier than--	Oct. 31	Oct. 22	Oct. 12

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-84 at Osceola, Iowa)

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	190	173	151
8 years in 10	197	179	157
5 years in 10	208	192	170
2 years in 10	220	204	183
1 year in 10	226	211	190

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
13B	Olmitz-Zook-Colo complex, 0 to 5 percent slopes	21,630	7.9
23C	Arispe silty clay loam, 5 to 9 percent slopes	6,255	2.3
23C2	Arispe silty clay loam, 5 to 9 percent slopes, moderately eroded	25,875	9.4
24D	Shelby loam, 9 to 14 percent slopes	440	0.2
24D2	Shelby clay loam, 9 to 14 percent slopes, moderately eroded	1,430	0.5
24E	Shelby loam, 14 to 18 percent slopes	1,955	0.7
24E2	Shelby clay loam, 14 to 18 percent slopes, moderately eroded	14,045	5.1
24E3	Shelby clay loam, 14 to 18 percent slopes, severely eroded	735	0.3
24F	Shelby loam, 18 to 25 percent slopes	335	0.1
24F2	Shelby clay loam, 18 to 25 percent slopes, moderately eroded	1,920	0.7
51	Vesser silt loam, 0 to 2 percent slopes	400	0.1
51B	Vesser silt loam, 2 to 5 percent slopes	795	0.3
54	Zook silty clay loam, 0 to 2 percent slopes	2,015	0.7
54+	Zook silt loam, overwash, 0 to 2 percent slopes	720	0.3
56C	Cantril loam, 5 to 9 percent slopes	705	0.3
65D	Lindley loam, 9 to 14 percent slopes	255	0.1
65E	Lindley loam, 14 to 18 percent slopes	580	0.2
65F	Lindley loam, 18 to 25 percent slopes	4,520	1.6
65F2	Lindley clay loam, 18 to 25 percent slopes, moderately eroded	355	0.1
65G	Lindley loam, 25 to 40 percent slopes	430	0.2
69C	Clearfield silty clay loam, 5 to 9 percent slopes	215	0.1
69C2	Clearfield silty clay loam, 5 to 9 percent slopes, moderately eroded	905	0.3
76C2	Ladoga silty clay loam, 5 to 9 percent slopes, moderately eroded	980	0.4
87B	Zook-Colo silty clay loams, 0 to 5 percent slopes	1,565	0.6
93D	Shelby-Adair loams, 9 to 14 percent slopes	255	0.1
93D2	Shelby-Adair clay loams, 9 to 14 percent slopes, moderately eroded	3,770	1.4
93D3	Shelby-Adair clay loams, 9 to 14 percent slopes, severely eroded	820	0.3
94D	Caleb-Mystic loams, 9 to 14 percent slopes	875	0.3
94D2	Caleb-Mystic complex, 9 to 14 percent slopes, moderately eroded	2,610	1.0
94E2	Caleb-Mystic complex, 14 to 18 percent slopes, moderately eroded	665	0.2
131B	Pershing silt loam, 2 to 5 percent slopes	750	0.3
131C	Pershing silt loam, 5 to 9 percent slopes	6,230	2.3
131C2	Pershing silty clay loam, 5 to 9 percent slopes, moderately eroded	1,475	0.5
132C	Weller silt loam, 5 to 9 percent slopes	805	0.3
133	Colo silty clay loam, 0 to 2 percent slopes	1,440	0.5
133B	Colo silty clay loam, 2 to 5 percent slopes	360	0.1
179D	Gara loam, 9 to 14 percent slopes	430	0.2
179D2	Gara clay loam, 9 to 14 percent slopes, moderately eroded	315	0.1
179E	Gara loam, 14 to 18 percent slopes	4,325	1.6
179E2	Gara clay loam, 14 to 18 percent slopes, moderately eroded	7,820	2.8
179E3	Gara clay loam, 14 to 18 percent slopes, severely eroded	280	0.1
179F	Gara loam, 18 to 25 percent slopes	9,315	3.4
179F2	Gara clay loam, 18 to 25 percent slopes, moderately eroded	6,335	2.3
192C	Adair loam, 5 to 9 percent slopes	565	0.2
192C2	Adair clay loam, 5 to 9 percent slopes, moderately eroded	1,895	0.7
192D	Adair loam, 9 to 14 percent slopes	770	0.3
192D2	Adair clay loam, 9 to 14 percent slopes, moderately eroded	4,460	1.6
192D3	Adair clay loam, 9 to 14 percent slopes, severely eroded	320	0.1
211	Edina silt loam, 0 to 2 percent slopes	650	0.2
220	Nodaway silt loam, 0 to 2 percent slopes	1,685	0.6
222C	Clarinda silty clay loam, 5 to 9 percent slopes	1,020	0.4
222C2	Clarinda silty clay loam, 5 to 9 percent slopes, moderately eroded	13,080	4.8
222C3	Clarinda silty clay, 5 to 9 percent slopes, severely eroded	730	0.3
222D2	Clarinda silty clay loam, 9 to 14 percent slopes, moderately eroded	945	0.3
269	Humeston silt loam, 0 to 2 percent slopes	285	0.1
273B	Olmitz loam, 2 to 5 percent slopes	1,365	0.5
273C	Olmitz loam, 5 to 9 percent slopes	1,465	0.5
362	Haig silt loam, 0 to 2 percent slopes	9,400	3.4
364B	Grundy silty clay loam, 2 to 5 percent slopes	21,785	8.0
368	Macksburg silty clay loam, 0 to 2 percent slopes	655	0.2
368B	Macksburg silty clay loam, 2 to 5 percent slopes	3,010	1.1
369	Winterset silty clay loam, 0 to 2 percent slopes	380	0.1
370B	Sharpsburg silty clay loam, 2 to 5 percent slopes	1,040	0.4

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
370C	Sharpsburg silty clay loam, 5 to 9 percent slopes	1,840	0.7
370C2	Sharpsburg silty clay loam, 5 to 9 percent slopes, moderately eroded	1,300	0.5
423C2	Bucknell silty clay loam, 5 to 9 percent slopes, moderately eroded	275	0.1
423D	Bucknell silty clay loam, 9 to 14 percent slopes	1,305	0.5
423D2	Bucknell silty clay loam, 9 to 14 percent slopes, moderately eroded	4,100	1.5
425D	Keswick loam, 9 to 14 percent slopes	2,460	0.9
425D2	Keswick clay loam, 9 to 14 percent slopes, moderately eroded	400	0.1
430	Ackmore silt loam, 0 to 2 percent slopes	810	0.3
452C2	Lineville silt loam, 5 to 9 percent slopes, moderately eroded	420	0.2
484	Lawson silt loam, 0 to 2 percent slopes	1,965	0.7
570C	Nira silty clay loam, 5 to 9 percent slopes	310	0.1
570C2	Nira silty clay loam, 5 to 9 percent slopes, moderately eroded	3,090	1.1
592C2	Mystic clay loam, 5 to 9 percent slopes, moderately eroded	670	0.2
592D2	Mystic clay loam, 9 to 14 percent slopes, moderately eroded	335	0.1
730C	Cantril-Nodaway complex, 0 to 9 percent slopes	900	0.3
792C	Armstrong loam, 5 to 9 percent slopes	870	0.3
792C2	Armstrong clay loam, 5 to 9 percent slopes, moderately eroded	440	0.2
792D	Armstrong loam, 9 to 14 percent slopes	6,360	2.3
792D2	Armstrong clay loam, 9 to 14 percent slopes, moderately eroded	7,900	2.9
792D3	Armstrong clay loam, 9 to 14 percent slopes, severely eroded	210	0.1
822C	Lamoni clay loam, 5 to 9 percent slopes	535	0.2
822C2	Lamoni clay loam, 5 to 9 percent slopes, moderately eroded	4,110	1.5
822C3	Lamoni clay loam, 5 to 9 percent slopes, severely eroded	355	0.1
822D	Lamoni clay loam, 9 to 14 percent slopes	740	0.3
822D2	Lamoni clay loam, 9 to 14 percent slopes, moderately eroded	18,670	6.8
822D3	Lamoni clay loam, 9 to 14 percent slopes, severely eroded	1,445	0.5
892C2	Mystic Variant silty clay loam, 5 to 9 percent slopes, moderately eroded	290	0.1
993D2	Gara-Armstrong clay loams, 9 to 14 percent slopes, moderately eroded	1,145	0.4
993E2	Gara-Armstrong clay loams, 14 to 18 percent slopes, moderately eroded	735	0.3
1715	Nodaway-Lawson silt loams, channeled, 0 to 2 percent slopes	4,765	1.7
5030	Pits, limestone quarries	143	0.1
5040	Orthents, loamy	293	0.1
	Water	1,870	0.7
	Total	274,496	100.0

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
13B	Olmitz-Zook-Colo complex, 0 to 5 percent slopes (where drained)
51	Vesser silt loam, 0 to 2 percent slopes (where drained)
51B	Vesser silt loam, 2 to 5 percent slopes (where drained)
54	Zook silty clay loam, 0 to 2 percent slopes (where drained)
54+	Zook silt loam, overwash, 0 to 2 percent slopes (where drained)
87B	Zook-Colo silty clay loams, 0 to 5 percent slopes (where drained)
131B	Pershing silt loam, 2 to 5 percent slopes
133	Colo silty clay loam, 0 to 2 percent slopes (where drained)
133B	Colo silty clay loam, 2 to 5 percent slopes (where drained)
211	Edina silt loam, 0 to 2 percent slopes (where drained)
220	Nodaway silt loam, 0 to 2 percent slopes
269	Humeston silt loam, 0 to 2 percent slopes (where drained)
273B	Olmitz loam, 2 to 5 percent slopes
362	Haig silt loam, 0 to 2 percent slopes (where drained)
364B	Grundy silty clay loam, 2 to 5 percent slopes
368	Macksburg silty clay loam, 0 to 2 percent slopes
368B	Macksburg silty clay loam, 2 to 5 percent slopes
369	Winterset silty clay loam, 0 to 2 percent slopes (where drained)
370B	Sharpsburg silty clay loam, 2 to 5 percent slopes
430	Ackmore silt loam, 0 to 2 percent slopes (where drained)
484	Lawson silt loam, 0 to 2 percent slopes

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
		Bu	Bu	Bu	Tons	AUM*	AUM*	AUM*
13B------------- Olmitz-Zook-Colo	IIw	132	44	73	---	3.9	5.1	---
23C------------- Arispe	IIIe	128	43	64	---	3.8	6.3	7.3
23C2------------ Arispe	IIIe	124	42	62	---	3.7	6.1	7.1
24D------------- Shelby	IIIe	119	40	60	---	3.3	5.0	5.8
24D2------------ Shelby	IIIe	115	39	58	---	3.3	4.9	5.6
24E------------- Shelby	IVe	102	34	51	---	2.3	4.1	4.8
24E2------------ Shelby	IVe	98	33	49	---	2.1	4.0	4.5
24E3------------ Shelby	IVe	102	34	51	---	2.3	4.1	4.8
24F, 24F2------- Shelby	VIe	---	---	---	---	1.7	---	---
51-------------- Vesser	IIw	130	44	65	3.9	3.7	5.0	5.6
51B------------- Vesser	IIw	127	43	64	3.8	3.7	4.9	5.5
54, 54+--------- Zook	IIw	126	42	76	3.8	4.0	4.0	---
56C------------- Cantril	IIe	113	38	57	4.5	3.3	5.0	6.6
65D------------- Lindley	IVe	101	34	---	3.0	---	6.0	---
65E------------- Lindley	VIe	---	---	---	2.2	---	4.4	---
65F------------- Lindley	VIIe	---	---	---	---	---	2.0	---
65F2------------ Lindley	VIIe	---	---	---	---	---	1.5	---
65G------------- Lindley	VIIe	---	---	---	---	---	2.0	---
69C------------- Clearfield	IIIw	112	38	56	---	3.5	5.9	6.0

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
		Bu	Bu	Bu	Tons	AUM*	AUM*	AUM*
69C2------------ Clearfield	IIIw	108	36	54	---	3.5	5.8	5.8
76C2------------ Ladoga	IIIe	139	47	76	---	3.9	6.3	7.3
87B------------- Zook-Colo	IIw	130	43	79	4.0	4.1	4.6	---
93D------------- Shelby-Adair	IVe	106	36	54	---	2.8	4.5	5.3
93D2------------ Shelby-Adair	IVe	99	33	50	---	2.8	4.1	4.9
93D3------------ Shelby-Adair	VIe	---	---	---	---	2.5	3.5	4.2
94D------------- Caleb-Mystic	IVe	85	29	43	---	2.2	3.8	4.5
94D2------------ Caleb-Mystic	IVe	76	25	38	---	2.1	3.3	4.1
94E2------------ Caleb-Mystic	VIe	---	---	30	---	1.5	2.8	2.9
131B------------ Pershing	IIIe	119	40	60	---	3.8	6.0	7.0
131C------------ Pershing	IIIe	114	38	57	---	3.5	5.7	6.6
131C2----------- Pershing	IIIe	107	36	54	---	3.4	5.4	6.3
132C------------ Weller	IIIe	100	34	50	4.2	3.7	5.4	6.3
133, 133B------- Colo	IIw	136	46	82	4.2	4.2	5.5	7.0
179D------------ Gara	IVe	110	37	55	---	2.7	4.7	5.5
179D2----------- Gara	IVe	106	36	53	---	2.5	4.5	5.1
179E------------ Gara	VIe	---	---	---	---	1.7	3.3	4.1
179E2----------- Gara	VIe	---	---	---	---	1.5	---	3.8
179E3----------- Gara	VIe	---	---	---	---	1.7	3.3	4.1
179F------------ Gara	VIe	---	---	---	---	1.3	---	2.5

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
		Bu	Bu	Bu	Tons	AUM*	AUM*	AUM*
179F2----------- Gara	VIIe	---	---	---	---	1.3	---	2.0
192C------------ Adair	IIIe	92	31	46	---	2.7	4.0	5.1
192C2----------- Adair	IIIe	85	28	43	---	2.3	3.5	4.5
192D------------ Adair	IVe	83	28	42	---	2.0	3.3	4.3
192D2----------- Adair	IVe	76	25	38	---	1.9	2.9	3.8
192D3----------- Adair	VIe	---	---	---	---	1.5	2.0	2.6
211------------- Edina	IIIw	80	30	---	---	---	6.5	---
220------------- Nodaway	IIw	153	51	92	---	4.0	6.5	7.6
222C------------ Clarinda	IVw	82	27	41	---	2.7	3.7	4.3
222C2----------- Clarinda	IVw	72	24	36	---	2.3	3.3	3.6
222C3----------- Clarinda	VIe	---	---	---	---	1.5	2.8	2.5
222D2----------- Clarinda	IVe	66	22	33	---	1.7	2.9	3.0
269------------- Humeston	IIIw	110	37	55	---	3.3	5.0	6.1
273B------------ Olmitz	IIe	137	46	69	---	3.9	6.0	7.0
273C------------ Olmitz	IIIe	132	44	66	---	3.7	5.7	6.6
362------------- Haig	IIw	131	44	66	3.9	3.8	6.2	7.0
364B------------ Grundy	IIe	133	45	67	4.4	---	8.8	---
368------------- Macksburg	I	164	55	82	---	4.5	8.4	---
368B------------ Macksburg	IIe	161	54	81	---	4.2	8.2	---
369------------- Winterset	IIw	159	53	80	---	4.3	8.2	---

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
		Bu	Bu	Bu	Tons	AUM*	AUM*	AUM*
370B------------ Sharpsburg	IIe	153	51	71	6.4	4.2	6.7	7.8
370C------------ Sharpsburg	IIIe	148	50	74	6.2	4.1	6.5	7.5
370C2----------- Sharpsburg	IIIe	144	48	72	6.1	4.0	6.5	7.3
423C2----------- Bucknell	IIIe	73	24	37	---	2.5	4.0	4.8
423D------------ Bucknell	IVe	74	25	37	---	2.1	3.7	4.4
423D2----------- Bucknell	IVe	67	22	34	---	1.9	3.5	4.1
425D------------ Keswick	IVe	65	22	33	---	1.9	3.1	3.6
425D2----------- Keswick	IVe	62	21	31	---	1.3	2.7	3.0
430------------- Ackmore	IIw	141	47	85	---	3.8	6.3	7.5
452C2----------- Lineville	IIIe	92	31	46	---	2.5	3.5	---
484------------- Lawson	IIw	130	43	80	---	4.6	---	---
570C------------ Nira	IIIe	147	49	81	6.2	4.1	6.5	7.6
570C2----------- Nira	IIIe	143	48	79	6.0	3.9	6.3	7.5
592C2----------- Mystic	IIIe	68	23	35	---	2.0	2.9	3.9
592D2----------- Mystic	IVe	59	20	30	---	1.9	2.3	3.3
730C------------ Cantril-Nodaway	IIIe	126	41	70	---	3.5	5.5	6.8
792C------------ Armstrong	IIIe	83	28	42	---	2.3	3.3	4.5
792C2----------- Armstrong	IIIe	73	24	37	---	2.1	3.1	4.1
792D------------ Armstrong	IVe	74	25	37	---	2.0	3.1	3.8
792D2----------- Armstrong	IVe	67	22	34	---	1.7	---	3.3

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
		Bu	Bu	Bu	Tons	AUM*	AUM*	AUM*
792D3----------- Armstrong	VIe	---	---	---	---	1.3	1.7	2.3
822C------------ Lamoni	IIIe	92	31	46	---	3.0	4.5	5.3
822C2----------- Lamoni	IIIe	82	27	41	---	2.7	4.3	5.0
822C3----------- Lamoni	IVe	62	21	31	---	2.1	3.7	4.3
822D------------ Lamoni	IVe	83	28	42	---	2.3	4.0	4.5
822D2----------- Lamoni	IVe	76	25	38	---	2.1	3.7	4.3
822D3----------- Lamoni	VIe	---	---	---	---	1.9	---	2.5
892C2----------- Mystic Variant	IVe	42	16	23	---	1.7	2.5	2.8
993D2----------- Gara-Armstrong	IVe	91	31	46	---	2.2	---	4.4
993E2----------- Gara-Armstrong	VIe	---	---	---	---	1.4	---	3.2
1715------------ Nodaway-Lawson	Vw	---	---	---	---	4.0	---	---
5030**. Pits								
5040**. Orthents								

* 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	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Productivity class*	Trees to plant
56C------------- Cantril	4A	Slight	Slight	Slight	Slight	White oak-----------	75	4	Eastern white pine, red pine, white spruce, sugar maple.
65D------------- Lindley	3A	Slight	Slight	Slight	Slight	White oak-----------	60	3	White oak, green ash, yellow poplar, northern red oak, black oak.
						Post oak------------	---	---	
						Blackjack oak-------	---	---	
						Black oak-----------	---	---	
65E, 65F-------- Lindley	3R	Moderate	Moderate	Slight	Slight	White oak-----------	60	3	White oak, green ash, yellow poplar, northern red oak, black oak.
						Post oak------------	---	---	
						Blackjack oak-------	---	---	
						Black oak-----------	---	---	
65F2------------ Lindley	2R	Moderate	Moderate	Moderate	Slight	Blackjack oak-------	50	2	White oak, green ash, yellow poplar, black oak.
						Black oak-----------	---	---	
65G------------- Lindley	3R	Moderate	Moderate	Slight	Slight	White oak-----------	60	3	White oak, green ash, yellow poplar, northern red oak, black oak.
						Post oak------------	---	---	
						Blackjack oak-------	---	---	
						Black oak-----------	---	---	
76C2------------ Ladoga	4A	Slight	Slight	Slight	Slight	White oak-----------	75	4	Eastern white pine, red pine, white oak, sugar maple, northern red oak, European larch, black walnut.
						Northern red oak----	75	4	
94D**, 94D2**: Caleb-----------	3A	Slight	Slight	Slight	Slight	White oak-----------	55	3	Eastern white pine, red pine, black walnut, sugar maple.
						Northern red oak----	55	3	
Mystic----------	3A	Slight	Slight	Slight	Slight	White oak-----------	55	3	Eastern white pine, red pine, black walnut, sugar maple.
						Northern red oak----	55	3	

See footnotes at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Productivity class*	Trees to plant
94E2**:									
Caleb	3R	Moderate	Moderate	Slight	Slight	White oak Northern red oak	55 55	3 3	Eastern white pine, red pine, black walnut, sugar maple.
Mystic	3R	Slight	Moderate	Slight	Slight	White oak Northern red oak	55 55	3 3	Eastern white pine, red pine, black walnut, sugar maple.
131B, 131C, 131C2 Pershing	3C	Slight	Slight	Severe	Severe	White oak	55	3	Eastern white pine, white oak, red pine.
132C Weller	3C	Slight	Slight	Severe	Severe	White oak	55	3	Eastern white pine, red pine, black walnut, sugar maple.
179D, 179D2 Gara	3A	Slight	Slight	Slight	Slight	White oak Northern red oak	55 55	3 3	Eastern white pine, red pine, white oak, northern red oak.
179E, 179E2, 179E3, 179F, 179F2 Gara	3R	Moderate	Moderate	Slight	Slight	White oak Northern red oak	55 55	3 3	Eastern white pine, red pine, white oak, northern red oak.
220 Nodaway	3A	Slight	Slight	Slight	Slight	White oak	65	3	Eastern white pine, red pine, black walnut, sugar maple, European larch.
423C2, 423D, 423D2 Bucknell	2C	Slight	Slight	Slight	Moderate	White oak Northern red oak	50 50	2 2	Silver maple, American sycamore, green ash, hackberry, eastern redcedar.
425D, 425D2 Keswick	3C	Slight	Slight	Slight	Moderate	White oak Northern red oak	55 55	3 3	Eastern white pine, red pine, sugar maple.

See footnotes at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Productivity class*	Trees to plant
430---------- Ackmore	3A	Slight	Slight	Slight	Slight	White oak----------	65	3	Eastern white pine, red pine, cottonwood, sugar maple, black walnut.
452C2---------- Lineville	3A	Slight	Slight	Slight	Slight	White oak----------	55	3	Eastern white pine, red pine, Norway spruce, white spruce, sugar maple.
484---------- Lawson	2A	Slight	Slight	Slight	Slight	Silver maple-------- White ash---------- Red maple----------	70 --- ---	2 --- ---	White spruce, silver maple, white ash.
592C2, 592D2---- Mystic	3A	Slight	Slight	Slight	Slight	White oak---------- Northern red oak----	55 55	3 3	Eastern white pine, red pine, black walnut, sugar maple.
730C**:									
Cantril--------	4A	Slight	Slight	Slight	Slight	White oak----------	75	4	Eastern white pine, red pine, white spruce, sugar maple.
Nodaway--------	3A	Slight	Slight	Slight	Slight	White oak----------	65	3	Eastern white pine, red pine, black walnut, sugar maple, European larch.
792C, 792C2, 792D, 792D2, 792D3---------- Armstrong	3C	Slight	Slight	Severe	Severe	White oak---------- Northern red oak----	55 55	3 3	Eastern white pine, red pine, European larch, sugar maple.
892C2---------- Mystic Variant	2W	Slight	Severe	Moderate	Moderate	White oak---------- Northern red oak----	45 45	2 2	Silver maple, American sycamore, green ash, hackberry, eastern redcedar, white spruce, Norway spruce.

See footnotes at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Productivity class*	Trees to plant
993D2**:									
Gara	3A	Slight	Slight	Slight	Slight	White oak Northern red oak	55 55	3 3	Eastern white pine, red pine, white oak, northern red oak.
Armstrong	3C	Slight	Slight	Severe	Severe	White oak Northern red oak	55 55	3 3	Eastern white pine, red pine, European larch, sugar maple.
993E2**:									
Gara	3R	Moderate	Moderate	Slight	Slight	White oak Northern red oak	55 55	3 3	Eastern white pine, red pine, white oak, northern red oak.
Armstrong	3R	Moderate	Moderate	Severe	Severe	White oak Northern red oak	55 55	3 3	Eastern white pine, red pine, European larch, sugar maple.
1715**:									
Nodaway	3A	Slight	Slight	Slight	Slight	White oak	65	3	Eastern white pine, red pine, black walnut, sugar maple, European larch.
Lawson	2W	Slight	Moderate	Slight	Slight	Silver maple White ash Red maple	70 --- ---	2 --- ---	White spruce, silver maple, white ash.

* Productivity class is the yield in cubic meters per hectare per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--			
	8-15	16-25	26-35	>35
13B*:				
Olmitz	Amur honeysuckle, Amur privet, silky dogwood, American cranberrybush.	White fir, blue spruce, northern whitecedar, Washington hawthorn.	Austrian pine, Norway spruce.	Pin oak, eastern white pine.
Zook	Silky dogwood, Amur honeysuckle, American cranberrybush, Amur privet.	Norway spruce, northern white-cedar, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
Colo	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, blue spruce, white fir, northern white-cedar, Washington hawthorn.	Eastern white pine	Pin oak.
23C, 23C2 Arispe	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	White fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
24D, 24D2, 24E, 24E2, 24E3, 24F, 24F2 Shelby	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, northern white-cedar, blue spruce, white fir.	Norway spruce, Austrian pine.	Pin oak, eastern white pine.
51, 51B Vesser	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern white-cedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
54, 54+ Zook	Silky dogwood, Amur honeysuckle, American cranberrybush, Amur privet.	Norway spruce, northern white-cedar, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--			
	8-15	16-25	26-35	>35
56C: Cantril	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, northern white-cedar, blue spruce, white fir, Austrian pine.	Norway spruce	Pin oak, eastern white pine.
65D, 65E, 65F, 65F2, 65G: Lindley	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Northern white-cedar, Washington hawthorn, blue spruce, white fir.	Norway spruce, Austrian pine.	Pin oak, eastern white pine.
69C, 69C2: Clearfield	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Austrian pine, blue spruce, white fir, northern white-cedar, Washington hawthorn, Norway spruce.	Eastern white pine	Pin oak.
76C2: Ladoga	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	White fir, blue spruce, northern whitecedar, Washington hawthorn.	Austrian pine, Norway spruce.	Eastern white pine, pin oak.
87B*:				
Zook	Silky dogwood, Amur honeysuckle, American cranberrybush, Amur privet.	Norway spruce, northern white-cedar, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
Colo	Redosier dogwood, American plum.	White fir, white spruce, hackberry, Amur maple, tall purple willow.	Green ash, golden willow.	Silver maple, eastern cottonwood.
93D*, 93D2*, 93D3*:				
Shelby	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, northern white-cedar, blue spruce, white fir.	Norway spruce, Austrian pine.	Pin oak, eastern white pine.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- 8-15	16-25	26-35	>35
93D*, 93D2*, 93D3*:				
Adair	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Amur honeysuckle, American cranberrybush.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---
94D*, 94D2*, 94E2*:				
Caleb	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	White fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
Mystic	American cranberrybush, Amur honeysuckle, eastern redcedar, arrowwood, Amur privet, Washington hawthorn.	Osageorange, green ash, Austrian pine.	Pin oak, eastern white pine.	---
131B, 131C, 131C2-Pershing	Eastern redcedar, Washington hawthorn, Amur privet, Amur honeysuckle, arrowwood, American cranberrybush.	Austrian pine, Osageorange, green ash.	Eastern white pine, pin oak.	---
132C Weller	American cranberrybush, Amur honeysuckle, arrowwood, Washington hawthorn, Amur privet, eastern redcedar.	Osageorange, green ash, Austrian pine.	Pin oak, eastern white pine.	---
133, 133B Colo	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, blue spruce, white fir, northern white-cedar, Washington hawthorn.	Eastern white pine	Pin oak.
179D, 179D2, 179E, 179E2, 179E3, 179F, 179F2 Gara	Amur honeysuckle, American cranberrybush, Amur privet, silky dogwood.	Northern white-cedar, white fir, Washington hawthorn, blue spruce.	Austrian pine, Norway spruce.	Eastern white pine, pin oak.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--			
	8-15	16-25	26-35	>35
192C, 192C2, 192D, 192D2, 192D3----- Adair	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Amur honeysuckle, American cranberrybush.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---
211--------------- Edina	Amur honeysuckle, Amur privet, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, blue spruce, northern white-cedar, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
220--------------- Nodaway	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
222C, 222C2, 222C3, 222D2----- Clarinda	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Amur honeysuckle, American cranberrybush.	Green ash, Osageorange.	Eastern white pine, pin oak, Austrian pine.	---
269--------------- Humeston	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern white-cedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
273B, 273C-------- Olmitz	Amur honeysuckle, Amur privet, silky dogwood, American cranberrybush.	White fir, blue spruce, northern whitecedar, Washington hawthorn.	Austrian pine, Norway spruce.	Pin oak, eastern white pine.
362--------------- Haig	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Norway spruce, Austrian pine, blue spruce, white fir, northern white-cedar, Washington hawthorn.	Eastern white pine	Pin oak.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--			
	8-15	16-25	26-35	>35
364B Grundy	Washington hawthorn, Amur honeysuckle, Amur privet, American cranberrybush, arrowwood, eastern redcedar.	Austrian pine, Osageorange, green ash.	Pin oak, eastern white pine.	---
368, 368B Macksburg	American cranberrybush, Amur honeysuckle, Amur privet, silky dogwood.	Northern white-cedar, blue spruce, Washington hawthorn, white fir, Austrian pine.	Norway spruce	Eastern white pine, pin oak.
369 Winterset	American cranberrybush, Amur privet, silky dogwood, Amur honeysuckle.	Austrian pine, Washington hawthorn, blue spruce, northern whitecedar, white fir, Norway spruce.	Eastern white pine	Pin oak.
370B, 370C, 370C2 Sharpsburg	Silky dogwood, Amur honeysuckle, American cranberrybush, Amur privet.	White fir, blue spruce, northern whitecedar, Washington hawthorn.	Austrian pine, Norway spruce.	Eastern white pine, pin oak.
423C2, 423D, 423D2 Bucknell	Eastern redcedar, arrowwood, Washington hawthorn, Amur privet, Amur honeysuckle, American cranberrybush.	Green ash, Austrian pine, Osageorange.	Eastern white pine, pin oak.	---
425D, 425D2 Keswick	Eastern redcedar, Washington hawthorn, arrowwood, Amur privet, Amur honeysuckle, American cranberrybush.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---
430 Ackmore	Silky dogwood, Amur honeysuckle, Amur privet, American cranberrybush.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--			
	8-15	16-25	26-35	>35
452C2: Lineville	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Amur honeysuckle, American cranberrybush.	Austrian pine, Osageorange, green ash.	Eastern white pine, pin oak.	---
484: Lawson	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.
570C, 570C2: Nira	Amur honeysuckle, silky dogwood, Amur privet, American cranberrybush.	White fir, blue spruce, Washington hawthorn, northern white-cedar.	Austrian pine, Norway spruce.	Eastern white pine, pin oak.
592C2, 592D2: Mystic	American cranberrybush, Amur honeysuckle, eastern redcedar, arrowwood, Amur privet, Washington hawthorn.	Osageorange, green ash, Austrian pine.	Pin oak, eastern white pine.	---
730C*:				
Cantril	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, northern white-cedar, blue spruce, white fir, Austrian pine.	Norway spruce	Pin oak, eastern white pine.
Nodaway	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.
792C, 792C2, 792D, 792D2, 792D3: Armstrong	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, American cranberrybush, Amur honeysuckle.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--			
	8-15	16-25	26-35	>35
822C, 822C2, 822C3, 822D, 822D2, 822D3----- Lamoni	Eastern redcedar, Washington hawthorn, arrowwood, Amur honeysuckle, Amur privet, American cranberrybush.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---
892C2------------- Mystic Variant	American cranberrybush, Amur honeysuckle, eastern redcedar, arrowwood, Amur privet, Washington hawthorn.	Green ash, Osageorange, Austrian pine.	Pin oak, eastern white pine.	---
993D2*, 993E2*: Gara-------------	Amur honeysuckle, American cranberrybush, Amur privet, silky dogwood.	Northern white-cedar, white fir, Washington hawthorn, blue spruce.	Austrian pine, Norway spruce.	Eastern white pine, pin oak.
Armstrong--------	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, American cranberrybush, Amur honeysuckle.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---
1715*: Nodaway----------	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
Lawson-----------	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
5030*. Pits				
5040*. Orthents				

* 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
13B*:					
Olmitz	Slight	Slight	Moderate: slope.	Slight	Slight.
Zook	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Colo	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
23C, 23C2 Arispe	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Slight	Slight.
24D, 24D2 Shelby	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.
24E, 24E2, 24E3, 24F, 24F2 Shelby	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
51, 51B Vesser	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
54, 54+ Zook	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
56C Cantril	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
65D Lindley	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.
65E, 65F, 65F2 Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
65G Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
69C, 69C2 Clearfield	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
76C2 Ladoga	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight	Slight.
87B*:					
Zook	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.

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
87B*:					
Colo	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
93D*, 93D2*, 93D3*:					
Shelby	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.
Adair	Severe: wetness.	Moderate: wetness, slope, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: slope, wetness.
94D*, 94D2*:					
Caleb	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Mystic	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
94E2*:					
Caleb	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Mystic	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
131B Pershing	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight	Slight.
131C, 131C2 Pershing	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Slight	Slight.
132C Weller	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Slight	Slight.
133, 133B Colo	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
179D, 179D2 Gara	Moderate: percs slowly, slope.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.
179E, 179E2, 179E3, 179F, 179F2 Gara	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
192C, 192C2 Adair	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.

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
192D, 192D2, 192D3: Adair	Severe: wetness.	Moderate: wetness, slope, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: slope, wetness.
211: Edina	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
220: Nodaway	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
222C, 222C2: Clarinda	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
222C3: Clarinda	Severe: wetness, percs slowly.	Severe: too clayey, percs slowly.	Severe: slope, too clayey, wetness.	Severe: too clayey.	Severe: too clayey.
222D2: Clarinda	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness, slope.
269: Humeston	Severe: flooding, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
273B: Olmitz	Slight	Slight	Moderate: slope.	Slight	Slight.
273C: Olmitz	Slight	Slight	Severe: slope.	Slight	Slight.
362: Haig	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
364B: Grundy	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
368: Macksburg	Moderate: percs slowly, wetness.	Moderate: percs slowly, wetness.	Moderate: percs slowly, wetness.	Slight	Slight.
368B: Macksburg	Moderate: percs slowly, wetness.	Moderate: percs slowly, wetness.	Moderate: slope, wetness, percs slowly.	Slight	Slight.
369: Winterset	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
370B: Sharpsburg	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight	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
370C, 370C2 Sharpsburg	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight	Slight.
423C2 Bucknell	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
423D, 423D2 Bucknell	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness, slope.
425D, 425D2 Keswick	Severe: wetness.	Moderate: slope, wetness.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness, slope.
430 Ackmore	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
452C2 Lineville	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
484 Lawson	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
570C, 570C2 Nira	Slight	Slight	Severe: slope.	Slight	Slight.
592C2 Mystic	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight	Slight.
592D2 Mystic	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
730C*:					
Cantril	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
Nodaway	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
792C, 792C2 Armstrong	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
792D, 792D2, 792D3 Armstrong	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: slope, wetness.
822C, 822C2, 822C3 Lamoni	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
822D, 822D2, 822D3 Lamoni	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness.	Moderate: wetness.	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
892C2: Mystic Variant	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness, percs slowly.	Severe: erodes easily.	Moderate: wetness.
993D2*:					
Gara	Moderate: percs slowly, slope.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.
Armstrong	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: slope, wetness.
993E2*:					
Gara	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Armstrong	Severe: slope, wetness.	Severe: slope.	Severe: slope, wetness.	Moderate: slope, wetness.	Severe: slope.
1715*:					
Nodaway	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
Lawson	Severe: flooding, wetness.	Moderate: flooding, wetness.	Severe: wetness, flooding.	Moderate: wetness, flooding.	Severe: flooding.
5030*. Pits					
5040*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
13B*:										
Olmitz	Good	Good	Fair	Good	Good	Poor	Poor	Good	Good	Poor.
Zook	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
Colo	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
23C, 23C2 Arispe	Good	Good	Good	Good	Good	Very poor.	Poor	Good	Good	Very poor.
24D, 24D2 Shelby	Fair	Good	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
24E, 24E2, 24E3, 24F, 24F2 Shelby	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
51, 51B Vesser	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
54, 54+ Zook	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
56C Cantril	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
65D Lindley	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
65E, 65F, 65F2 Lindley	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
65G Lindley	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
69C, 69C2 Clearfield	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
76C2 Ladoga	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Very poor.
87B*:										
Zook	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
Colo	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
93D*, 93D2*, 93D3*:										
Shelby	Fair	Good	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Adair	Fair	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
94D*, 94D2*:										
Caleb	Fair	Good	Fair	Good	Fair	Poor	Poor	Fair	Good	Poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
94D*, 94D2*: Mystic	Fair	Good	Fair	Good	Fair	Very poor.	Poor	Fair	Good	Very poor.
94E2*: Caleb	Poor	Good	Fair	Good	Fair	Very poor.	Very poor.	Poor	Good	Very poor.
Mystic	Poor	Fair	Fair	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.
131B Pershing	Good	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
131C, 131C2 Pershing	Fair	Fair	Fair	Fair	Fair	Very poor.	Poor	Fair	Fair	Very poor.
132C Weller	Fair	Fair	Fair	Fair	Fair	Very poor.	Poor	Fair	Fair	Very poor.
133, 133B Colo	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
179D, 179D2 Gara	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Poor.
179E, 179E2, 179E3, 179F, 179F2 Gara	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
192C, 192C2, 192D, 192D2, 192D3 Adair	Fair	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
211 Edina	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
220 Nodaway	Good	Good	Good	Good	Fair	Fair	Poor	Fair	Good	Fair.
222C, 222C2, 222C3, 222D2 Clarinda	Poor	Fair	Poor	Fair	Poor	Poor	Poor	Fair	Fair	Poor.
269 Humeston	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
273B Olmitz	Good	Good	Fair	Good	Good	Poor	Poor	Good	Good	Poor.
273C Olmitz	Fair	Good	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
362 Haig	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
364B Grundy	Fair	Good	Fair	Good	Good	Fair	Fair	Fair	Good	Fair.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hardwood trees	Conif-erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
368, 368B----------Macksburg	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
369----------------Winterset	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
370B---------------Sharpsburg	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
370C, 370C2--------Sharpsburg	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
423C2, 423D, 423D2-Bucknell	Fair	Good	Fair	Good	Fair	Poor	Poor	Fair	Good	Very poor.
425D, 425D2--------Keswick	Fair	Good	Fair	Good	Fair	Very poor.	Poor	Fair	Good	Very poor.
430----------------Ackmore	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
452C2--------------Lineville	Fair	Good	Fair	Good	Fair	Poor	Poor	Fair	Good	Poor.
484----------------Lawson	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
570C, 570C2--------Nira	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Very poor.
592C2, 592D2-------Mystic	Fair	Good	Fair	Good	Fair	Very poor.	Poor	Fair	Good	Very poor.
730C*:										
Cantril-----------	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Nodaway-----------	Good	Good	Good	Good	Fair	Fair	Poor	Fair	Good	Fair.
792C, 792C2, 792D, 792D2, 792D3------Armstrong	Fair	Good	Fair	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.
822C, 822C2, 822C3, 822D, 822D2, 822D3-------------Lamoni	Fair	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
892C2--------------Mystic Variant	Poor	Fair	Poor	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
993D2*:										
Gara--------------	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Poor.
Armstrong---------	Fair	Good	Fair	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.
993E2*:										
Gara--------------	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
993E2*:										
Armstrong----------	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
1715*:										
Nodaway------------	Poor	Fair	Fair	Poor	Poor	Good	Fair	Poor	Poor	Fair.
Lawson-------------	Good	Good	Fair	Good	Good	Fair	Fair	Good	Good	Fair.
5030*. Pits										
5040*. Orthents										

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
13B*:						
Olmitz	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Zook	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
Colo	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
23C, 23C2 Arispe	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, frost action, shrink-swell.	Slight.
24D, 24D2 Shelby	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
24E, 24E2, 24E3, 24F, 24F2 Shelby	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
51, 51B Vesser	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
54, 54+ Zook	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
56C Cantril	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, slope.	Severe: low strength, frost action.	Slight.
65D Lindley	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
65E, 65F, 65F2, 65G Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
69C, 69C2 Clearfield	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.

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
76C2: Ladoga	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
87B*:						
Zook	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
Colo	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
93D*, 93D2*, 93D3*:						
Shelby	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
Adair	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness.	Severe: shrink-swell, wetness, slope.	Severe: shrink-swell, low strength.	Moderate: slope, wetness.
94D*, 94D2*:						
Caleb	Moderate: wetness, slope.	Moderate: shrink-swell, slope.	Moderate: wetness, slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
Mystic	Moderate: too clayey, wetness, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: slope.
94E2*:						
Caleb	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Mystic	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope.
131B, 131C, 131C2: Pershing	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Slight.
132C: Weller	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell.	Severe: shrink-swell, frost action, low strength.	Slight.
133, 133B: Colo	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, 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
179D, 179D2-------- Gara	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
179E, 179E2, 179E3, 179F, 179F2------------ Gara	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
192C, 192C2-------- Adair	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, low strength.	Moderate: wetness.
192D, 192D2, 192D3------------ Adair	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness.	Severe: shrink-swell, wetness, slope.	Severe: shrink-swell, low strength.	Moderate: slope, wetness.
211---------------- Edina	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
220---------------- Nodaway	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, frost action, low strength.	Moderate: flooding.
222C, 222C2-------- Clarinda	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell.	Moderate: wetness.
222C3-------------- Clarinda	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
222D2-------------- Clarinda	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: wetness, slope.
269---------------- Humeston	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, wetness, low strength.	Severe: wetness.
273B--------------- Olmitz	Slight----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
273C--------------- Olmitz	Slight----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
362---------------- Haig	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.

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
364B Grundy	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
368, 368B Macksburg	Severe: wetness.	Severe: shrink-swell.	Severe: wetness.	Severe: shrink-swell.	Severe: low strength, frost action, shrink-swell.	Slight.
369 Winterset	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
370B Sharpsburg	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
370C, 370C2 Sharpsburg	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
423C2 Bucknell	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
423D, 423D2 Bucknell	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: wetness, slope.
425D, 425D2 Keswick	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: wetness, slope.
430 Ackmore	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
452C2 Lineville	Severe: wetness.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
484 Lawson	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, frost action.	Moderate: wetness, flooding.
570C, 570C2 Nira	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
592C2 Mystic	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
592D2------------- Mystic	Moderate: too clayey, wetness, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: slope.
730C*:						
Cantril----------	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, slope.	Severe: low strength, frost action.	Slight.
Nodaway----------	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, frost action, low strength.	Moderate: flooding.
792C, 792C2------- Armstrong	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell, low strength.	Moderate: wetness.
792D, 792D2, 792D3------------ Armstrong	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, wetness, slope.	Severe: shrink-swell, low strength.	Moderate: slope, wetness.
822C, 822C2, 822C3------------ Lamoni	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, low strength.	Moderate: wetness.
822D, 822D2, 822D3------------ Lamoni	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness, slope.	Severe: shrink-swell, low strength.	Moderate: wetness, slope.
892C2------------- Mystic Variant	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, frost action.	Moderate: wetness.
993D2*:						
Gara-------------	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
Armstrong--------	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, wetness, slope.	Severe: shrink-swell, low strength.	Moderate: slope, wetness.
993E2*:						
Gara-------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Armstrong--------	Severe: wetness, slope.	Severe: shrink-swell, wetness, slope.	Severe: slope, wetness, shrink-swell.	Severe: shrink-swell, wetness, slope.	Severe: shrink-swell, low strength, slope.	Severe: 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
1715*:						
Nodaway	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, frost action, low strength.	Severe: flooding.
Lawson	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, frost action.	Severe: flooding.
5030*. Pits						
5040*. Orthents						

* 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," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
13B*:					
Olmitz	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Zook	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
Colo	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
23C, 23C2 Arispe	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
24D, 24D2 Shelby	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.
24E, 24E2, 24E3, 24F, 24F2 Shelby	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
51, 51B Vesser	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
54, 54+ Zook	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
56C Cantril	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
65D Lindley	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
65E, 65F, 65F2, 65G Lindley	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
69C, 69C2 Clearfield	Severe: percs slowly, wetness.	Severe: slope.	Severe: wetness.	Severe: wetness.	Poor: wetness, hard to pack.
76C2 Ladoga	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
87B*:					
Zook	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
Colo	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
93D*, 93D2*, 93D3*:					
Shelby	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.
Adair	Severe: percs slowly, wetness.	Severe: slope, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
94D*, 94D2*:					
Caleb	Severe: wetness.	Severe: slope, wetness.	Moderate: wetness, slope, too clayey.	Moderate: slope.	Fair: too clayey, slope, wetness.
Mystic	Severe: wetness, percs slowly.	Severe: seepage, slope.	Severe: seepage, too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
94E2*:					
Caleb	Severe: wetness, slope.	Severe: slope, wetness.	Severe: slope.	Severe: slope.	Poor: slope.
Mystic	Severe: wetness, percs slowly, slope.	Severe: seepage, slope.	Severe: seepage, slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
131B Pershing	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
131C, 131C2 Pershing	Severe: percs slowly, wetness.	Severe: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
132C Weller	Severe: percs slowly, wetness.	Severe: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
133, 133B Colo	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
179D, 179D2 Gara	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.

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
179E, 179E2, 179E3, 179F, 179F2 Gara	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
192C, 192C2, 192D, 192D2, 192D3 Adair	Severe: percs slowly, wetness.	Severe: slope, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
211 Edina	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
220 Nodaway	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.
222C, 222C2, 222C3, 222D2 Clarinda	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
269 Humeston	Severe: wetness, percs slowly, flooding.	Severe: flooding.	Severe: wetness, too clayey, flooding.	Severe: wetness, flooding.	Poor: wetness, too clayey, hard to pack.
273B Olmitz	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
273C Olmitz	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
362 Haig	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
364B Grundy	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
368, 368B Macksburg	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
369 Winterset	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: hard to pack, wetness.
370B Sharpsburg	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
370C, 370C2 Sharpsburg	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
423C2, 423D, 423D2-- Bucknell	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
425D, 425D2--------- Keswick	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness.	Severe: wetness.	Poor: wetness.
430----------------- Ackmore	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness, hard to pack.
452C2--------------- Lineville	Severe: percs slowly, wetness.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
484----------------- Lawson	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
570C, 570C2--------- Nira	Moderate: wetness, percs slowly.	Severe: slope.	Severe: wetness.	Moderate: wetness.	Poor: hard to pack.
592C2--------------- Mystic	Severe: wetness, percs slowly.	Severe: seepage, slope.	Severe: seepage, too clayey.	Slight-----------	Poor: too clayey, hard to pack.
592D2--------------- Mystic	Severe: wetness, percs slowly.	Severe: seepage, slope.	Severe: seepage, too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
730C*:					
Cantril------------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
Nodaway------------	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.
792C, 792C2, 792D, 792D2, 792D3------- Armstrong	Severe: percs slowly, wetness.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
822C, 822C2, 822C3, 822D, 822D2, 822D3- Lamoni	Severe: percs slowly, wetness.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
892C2--------------- Mystic Variant	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness.	Severe: wetness.	Poor: wetness.
993D2*:					
Gara---------------	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.

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
993D2*:					
Armstrong----------	Severe: percs slowly, wetness.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
993E2*:					
Gara---------------	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Armstrong----------	Severe: percs slowly, slope, wetness.	Severe: slope.	Severe: slope, wetness, too clayey.	Severe: wetness, slope.	Poor: slope, too clayey, hard to pack.
1715*:					
Nodaway------------	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.
Lawson-------------	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
5030*. Pits					
5040*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
13B*:				
Olmitz	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Zook	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Colo	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
23C, 23C2 Arispe	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
24D Shelby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer, slope.
24D2 Shelby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
24E, 24E2, 24E3, 24F, 24F2 Shelby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
51, 51B Vesser	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
54, 54+ Zook	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
56C Cantril	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
65D Lindley	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
65E, 65F, 65F2 Lindley	Fair: slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
65G Lindley	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
69C, 69C2 Clearfield	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
76C2------------------ Ladoga	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
87B*:				
Zook-----------------	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Colo-----------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
93D*:				
Shelby---------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer, slope.
Adair----------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
93D2*, 93D3*:				
Shelby---------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
Adair----------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
94D*, 94D2*:				
Caleb----------------	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Mystic---------------	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
94E2*:				
Caleb----------------	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Mystic---------------	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
131B, 131C------------ Pershing	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
131C2----------------- Pershing	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
132C------------------ Weller	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
133, 133B------------- Colo	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
179D-------------------- Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, small stones.
179D2------------------- Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope, small stones.
179E, 179E2, 179E3, 179F, 179F2---------- Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
192C, 192C2, 192D, 192D2, 192D3--------- Adair	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
211--------------------- Edina	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
220--------------------- Nodaway	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
222C, 222C2, 222C3, 222D2---------------- Clarinda	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
269--------------------- Humeston	Poor: low strength, shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
273B, 273C------------ Olmitz	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
362--------------------- Haig	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
364B-------------------- Grundy	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
368, 368B-------------- Macksburg	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
369--------------------- Winterset	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
370B, 370C, 370C2----- Sharpsburg	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
423C2, 423D, 423D2---- Bucknell	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
425D, 425D2----------- Keswick	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
430: Ackmore	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
452C2: Lineville	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, thin layer.
484: Lawson	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
570C, 570C2: Nira	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
592C2, 592D2: Mystic	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
730C*:				
Cantril	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Nodaway	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
792C, 792C2, 792D, 792D2, 792D3: Armstrong	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
822C, 822C2, 822C3, 822D, 822D2, 822D3: Lamoni	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
892C2: Mystic Variant	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
993D2*:				
Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope, small stones.
Armstrong	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
993E2*:				
Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Armstrong	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope, thin layer.
1715*:				
Nodaway	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Lawson	Poor: 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 but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
13B*:						
Olmitz	Moderate: seepage, slope.	Slight	Severe: no water.	Deep to water	Favorable	Favorable.
Zook	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, flooding, frost action.	Wetness, percs slowly.	Wetness, percs slowly.
Colo	Moderate: seepage, slope.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action, slope.	Wetness	Wetness.
23C, 23C2 Arispe	Moderate: seepage, slope.	Moderate: hard to pack, wetness.	Severe: no water.	Frost action, slope.	Erodes easily, wetness.	Erodes easily.
24D, 24D2, 24E, 24E2, 24E3, 24F, 24F2 Shelby	Severe: slope.	Slight	Severe: no water.	Deep to water	Slope	Slope.
51 Vesser	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Erodes easily, wetness.	Wetness, erodes easily.
51B Vesser	Moderate: seepage, slope.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action, slope.	Erodes easily, wetness.	Wetness, erodes easily.
54, 54+ Zook	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, flooding, frost action.	Wetness, percs slowly.	Wetness, percs slowly.
56C Cantril	Moderate: seepage, slope.	Moderate: wetness.	Moderate: deep to water, slow refill.	Frost action, slope.	Wetness	Rooting depth.
65D, 65E, 65F, 65F2, 65G Lindley	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope	Slope.
69C, 69C2 Clearfield	Moderate: slope.	Moderate: thin layer, hard to pack, wetness.	Severe: no water.	Frost action, slope.	Wetness, erodes easily.	Wetness, erodes easily.
76C2 Ladoga	Moderate: seepage, slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
87B*:						
Zook	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, flooding, frost action.	Wetness, percs slowly.	Wetness, percs slowly.

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	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
87B*:						
Colo	Moderate: seepage, slope.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action, slope.	Wetness	Wetness.
93D*, 93D2*, 93D3*:						
Shelby	Severe: slope.	Slight	Severe: no water.	Deep to water	Slope	Slope.
Adair	Severe: slope.	Moderate: wetness.	Severe: no water.	Percs slowly, slope, frost action.	Slope, wetness.	Wetness, slope, percs slowly.
94D*, 94D2*, 94E2*:						
Caleb	Severe: slope.	Moderate: thin layer.	Severe: no water.	Deep to water	Slope	Slope, rooting depth.
Mystic	Severe: slope, seepage.	Moderate: thin layer, hard to pack.	Severe: no water.	Deep to water	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
131B, 131C, 131C2- Pershing	Moderate: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, frost action, slope.	Wetness, erodes easily.	Erodes easily, percs slowly.
132C Weller	Moderate: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Slope, percs slowly, frost action.	Wetness, erodes easily.	Percs slowly, erodes easily.
133 Colo	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness	Wetness.
133B Colo	Moderate: seepage, slope.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action, slope.	Wetness	Wetness.
179D, 179D2, 179E, 179E2, 179E3, 179F, 179F2 Gara	Severe: slope.	Slight	Severe: no water.	Deep to water	Slope	Slope.
192C, 192C2 Adair	Moderate: slope.	Moderate: wetness.	Severe: no water.	Percs slowly, slope, frost action.	Wetness	Wetness, percs slowly.
192D, 192D2, 192D3 Adair	Severe: slope.	Moderate: wetness.	Severe: no water.	Percs slowly, slope, frost action.	Slope, wetness.	Wetness, slope, percs slowly.
211 Edina	Slight	Severe: hard to pack, wetness.	Severe: no water.	Percs slowly	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
220 Nodaway	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
222C, 222C2, 222C3----------- Clarinda	Moderate: slope.	Severe: hard to pack.	Severe: no water.	Percs slowly, frost action, slope.	Erodes easily, wetness.	Wetness, erodes easily.
222D2----------- Clarinda	Severe: slope.	Severe: hard to pack.	Severe: no water.	Percs slowly, frost action, slope.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
269-------------- Humeston	Moderate: seepage.	Severe: wetness.	Severe: slow refill.	Percs slowly, frost action, flooding.	Wetness, percs slowly.	Percs slowly, wetness.
273B, 273C-------- Olmitz	Moderate: seepage, slope.	Slight---------	Severe: no water.	Deep to water	Favorable------	Favorable.
362-------------- Haig	Slight---------	Severe: wetness.	Severe: slow refill.	Percs slowly, frost action.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
364B------------- Grundy	Moderate: slope.	Severe: hard to pack.	Severe: no water.	Percs slowly, frost action, slope.	Erodes easily, wetness.	Wetness, erodes easily.
368-------------- Macksburg	Moderate: seepage.	Moderate: wetness.	Severe: slow refill.	Frost action---	Erodes easily, wetness.	Erodes easily.
368B------------- Macksburg	Moderate: seepage, slope.	Moderate: wetness.	Severe: slow refill.	Frost action, slope.	Erodes easily, wetness.	Erodes easily.
369-------------- Winterset	Slight---------	Severe: wetness.	Severe: slow refill.	Frost action---	Erodes easily, wetness.	Wetness, erodes easily.
370B, 370C, 370C2- Sharpsburg	Moderate: seepage, slope.	Slight---------	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
423C2------------ Bucknell	Moderate: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, slope.	Wetness, percs slowly.	Wetness, percs slowly.
423D, 423D2------- Bucknell	Severe: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, slope.	Slope, wetness, percs slowly.	Wetness, slope, percs slowly.
425D, 425D2------- Keswick	Severe: slope.	Moderate: wetness.	Severe: no water.	Percs slowly, frost action, slope.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
430-------------- Ackmore	Moderate: seepage.	Severe: hard to pack, wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness, erodes easily.	Wetness, erodes easily.
452C2------------ Lineville	Moderate: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, frost action, slope.	Erodes easily, wetness.	Wetness, erodes easily.
484-------------- Lawson	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Erodes easily, wetness.	Wetness, 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	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
570C, 570C2-------Nira	Moderate: seepage, slope.	Moderate: hard to pack.	Moderate: deep to water, slow refill.	Deep to water	Erodes easily	Erodes easily.
592C2-------------Mystic	Severe: seepage.	Moderate: thin layer, hard to pack.	Severe: no water.	Deep to water	Erodes easily, percs slowly.	Erodes easily, percs slowly.
592D2-------------Mystic	Severe: slope, seepage.	Moderate: thin layer, hard to pack.	Severe: no water.	Deep to water	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
730C*:						
Cantril-----------	Moderate: seepage, slope.	Moderate: wetness.	Moderate: deep to water, slow refill.	Frost action, slope.	Wetness---------	Rooting depth.
Nodaway-----------	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water	Erodes easily	Erodes easily.
792C, 792C2-------Armstrong	Moderate: slope.	Moderate: wetness, hard to pack.	Severe: no water.	Slope, percs slowly, frost action.	Percs slowly, wetness.	Percs slowly, wetness.
792D, 792D2, 792D3------------Armstrong	Severe: slope.	Moderate: wetness, hard to pack.	Severe: no water.	Slope, percs slowly, frost action.	Slope, percs slowly, wetness.	Percs slowly, slope, wetness.
822C, 822C2, 822C3------------Lamoni	Moderate: slope.	Moderate: wetness, hard to pack.	Severe: no water.	Percs slowly, slope.	Percs slowly, wetness.	Percs slowly, wetness.
822D, 822D2, 822D3------------Lamoni	Severe: slope.	Moderate: wetness, hard to pack.	Severe: no water.	Percs slowly, slope.	Slope, wetness, percs slowly.	Slope, wetness, percs slowly.
892C2-------------Mystic Variant	Moderate: slope.	Moderate: wetness.	Severe: no water.	Percs slowly, frost action, slope.	Erodes easily, wetness.	Wetness, erodes easily.
993D2*, 993E2*:						
Gara--------------	Severe: slope.	Slight----------	Severe: no water.	Deep to water	Slope-----------	Slope.
Armstrong---------	Severe: slope.	Moderate: wetness, hard to pack.	Severe: no water.	Slope, percs slowly, frost action.	Slope, percs slowly, wetness.	Percs slowly, slope, wetness.
1715*:						
Nodaway-----------	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water	Erodes easily	Erodes easily.
Lawson------------	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Erodes easily, wetness.	Wetness, 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: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
13B*:											
Olmitz----------	0-9	Loam-------------	CL	A-6	0	100	90-100	85-95	60-80	30-40	11-20
	9-31	Loam, clay loam	CL	A-6	0	100	90-100	85-95	60-80	30-40	11-20
	31-60	Clay loam--------	CL	A-6, A-7	0	100	90-100	85-95	60-80	35-45	15-25
Zook------------	0-19	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	45-65	20-35
	19-60	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
Colo------------	0-9	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	9-35	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
	35-60	Silty clay loam, clay loam, silt loam.	CL, CH	A-7	0	100	100	95-100	80-100	40-55	15-30
23C, 23C2-------- Arispe	0-13	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	20-30
	13-42	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	45-60	25-35
	42-60	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
24D------------- Shelby	0-9	Loam-------------	CL	A-6	0	95-100	85-95	75-90	55-70	30-40	10-20
	9-47	Clay loam--------	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
	47-60	Clay loam--------	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
24D2------------ Shelby	0-8	Clay loam--------	CL	A-6, A-7	0	90-95	85-95	75-90	55-70	35-45	15-25
	8-42	Clay loam--------	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
	42-60	Clay loam--------	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
24E------------- Shelby	0-9	Loam-------------	CL	A-6	0	95-100	85-95	75-90	55-70	30-40	10-20
	9-47	Clay loam--------	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
	47-60	Clay loam--------	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
24E2------------ Shelby	0-8	Clay loam--------	CL	A-6, A-7	0	90-95	85-95	75-90	55-70	35-45	15-25
	8-42	Clay loam--------	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
	42-60	Clay loam--------	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
24E3------------ Shelby	0-8	Clay loam--------	CL	A-6, A-7	0	90-95	85-95	75-90	55-70	35-45	15-25
	8-32	Clay loam--------	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
	32-60	Clay loam--------	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
24F------------- Shelby	0-10	Loam-------------	CL	A-6	0	95-100	85-95	75-90	55-70	30-40	10-20
	10-40	Clay loam--------	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
	40-60	Clay loam--------	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
24F2------------ Shelby	0-8	Clay loam--------	CL	A-6, A-7	0	90-95	85-95	75-90	55-70	35-45	15-25
	8-32	Clay loam--------	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
	32-60	Clay loam--------	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
51, 51B--------- Vesser	0-13	Silt loam--------	CL	A-6	0	100	100	98-100	95-100	30-40	10-20
	13-32	Silt loam--------	CL	A-6	0	100	100	98-100	95-100	30-40	10-20
	32-60	Silty clay loam	CL	A-7	0	100	100	98-100	95-100	40-50	15-25
54-------------- Zook	0-19	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	45-65	20-35
	19-60	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
54+ Zook	0-18	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
	18-25	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
	25-60	Silty clay loam, silty clay, silt loam.	CH, CL	A-7, A-6	0	100	100	95-100	95-100	35-80	10-50
56C Cantril	0-10	Loam	CL	A-6	0	100	100	85-95	65-75	30-40	11-20
	10-60	Clay loam	CL	A-6, A-7	0	100	100	90-100	70-88	35-45	15-25
65D, 65E, 65F Lindley	0-11	Loam	CL	A-6	0	95-100	90-100	85-95	50-65	25-35	10-15
	11-39	Clay loam, clay	CL, CH	A-6, A-7	0	95-100	90-100	85-95	55-75	30-45	12-20
	39-60	Loam, clay loam	CL	A-6	0	95-100	90-100	85-95	50-70	25-35	10-15
65F2 Lindley	0-6	Clay loam	CL	A-6	0	95-100	90-100	85-95	55-75	30-40	15-20
	6-40	Clay loam, clay	CL, CH	A-6, A-7	0	95-100	90-100	85-95	55-75	30-45	12-20
	40-60	Loam, clay loam	CL	A-6	0	95-100	90-100	85-95	50-70	25-35	10-15
65G Lindley	0-11	Loam	CL	A-6	0	95-100	90-100	85-95	50-65	25-35	10-15
	11-39	Clay loam, clay	CL, CH	A-6, A-7	0	95-100	90-100	85-95	55-75	30-45	12-20
	39-60	Loam, clay loam	CL	A-6	0	95-100	90-100	85-95	50-70	25-35	10-15
69C, 69C2 Clearfield	0-12	Silty clay loam	CH, CL	A-7	0	100	100	100	95-100	45-55	20-30
	12-50	Silty clay loam, silty clay.	CH	A-7	0	100	100	100	95-100	50-60	25-35
	50-60	Silty clay, silty clay loam, clay.	CH	A-7	0	100	100	95-100	80-90	55-70	35-45
76C2 Ladoga	0-7	Silty clay loam	CL	A-6	0	100	100	100	95-100	30-40	10-20
	7-54	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	100	95-100	40-55	25-35
	54-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	100	95-100	30-40	15-20
87B*:											
Zook	0-19	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	45-65	20-35
	19-60	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
Colo	0-9	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	9-35	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
	35-60	Silty clay loam, clay loam, silt loam.	CL, CH	A-7	0	100	100	95-100	80-100	40-55	15-30
93D*:											
Shelby	0-9	Loam	CL	A-6	0	95-100	85-95	75-90	55-70	30-40	10-20
	9-47	Clay loam	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
	47-60	Clay loam	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
Adair	0-8	Loam	CL, CL-ML	A-6, A-4	0	95-100	95-100	90-100	85-100	20-35	5-15
	8-42	Silty clay, clay, clay loam.	CL, CH	A-7	0	95-100	80-95	70-90	55-80	40-55	20-30
	42-60	Clay loam	CL	A-6, A-7	0	95-100	80-95	70-90	55-80	35-50	15-25
93D2*, 93D3*:											
Shelby	0-8	Clay loam	CL	A-6, A-7	0	90-95	85-95	75-90	55-70	35-45	15-25
	8-42	Clay loam	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
	42-60	Clay loam	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
93D2*, 93D3*:											
Adair-----------	0-8	Clay loam--------	CL	A-6	0	95-100	80-95	75-90	60-80	30-40	10-20
	8-42	Silty clay, clay, clay loam.	CL, CH	A-7	0	95-100	80-95	70-90	55-80	40-55	20-30
	42-60	Clay loam--------	CL	A-6, A-7	0	95-100	80-95	70-90	55-80	35-50	15-25
94D*:											
Caleb-----------	0-12	Loam-------------	CL	A-6	0	95-100	85-100	70-90	60-80	30-40	10-20
	12-48	Clay loam, loam, sandy clay loam.	CL	A-6, A-7	0	90-100	85-100	60-80	50-75	35-45	15-25
	48-60	Sandy clay loam, loam, clay loam.	SC, CL, SM-SC, CL-ML	A-6, A-4	0	95-100	85-100	70-90	35-80	20-40	5-20
Mystic----------	0-12	Loam-------------	CL	A-6, A-7	0	100	100	80-100	65-90	30-45	10-25
	12-50	Clay loam, clay, silty clay.	CL, CH	A-7	0	100	90-100	80-100	65-80	40-55	25-35
	50-60	Stratified sandy loam to clay.	SM-SC, SC, CL-ML, CL	A-4, A-2, A-6	0-5	90-100	80-100	65-95	30-60	20-35	5-15
94D2*, 94E2*:											
Caleb-----------	0-7	Loam-------------	CL	A-6	0	95-100	85-100	70-90	60-80	30-40	10-20
	7-46	Clay loam, loam, sandy clay loam.	CL	A-6, A-7	0	90-100	85-100	60-80	50-75	35-45	15-25
	46-60	Sandy clay loam, loam, clay loam.	SC, CL, SM-SC, CL-ML	A-6, A-4	0	95-100	85-100	70-90	35-80	20-40	5-20
Mystic----------	0-7	Clay loam--------	CL	A-6, A-7	0	100	100	80-100	65-90	30-45	10-25
	7-50	Clay loam, clay, silty clay.	CL, CH	A-7	0	100	90-100	80-100	65-80	40-55	25-35
	50-60	Stratified sandy loam to clay.	SM-SC, SC, CL-ML, CL	A-4, A-2, A-6	0-5	90-100	80-100	65-95	30-60	20-35	5-15
131B, 131C------- Pershing	0-7	Silt loam--------	CL	A-6	0	100	100	100	95-100	30-40	10-20
	7-12	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	15-30
	12-38	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-65	20-40
	38-60	Silty clay loam, silt loam.	CH, CL	A-7, A-6	0	100	100	100	95-100	35-55	20-35
131C2----------- Pershing	0-7	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	15-30
	7-11	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	15-30
	11-32	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-65	20-40
	32-60	Silty clay loam, silt loam.	CH, CL	A-7, A-6	0	100	100	100	95-100	35-55	20-35
132C------------ Weller	0-13	Silt loam--------	CL, CL-ML	A-6, A-4	0	100	100	100	95-100	25-40	5-15
	13-39	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	45-65	30-40
	39-60	Silty clay loam, silt loam.	CH, CL	A-7, A-6	0	100	100	100	95-100	30-55	10-30
133, 133B-------- Colo	0-9	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	9-35	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
	35-60	Silty clay loam, clay loam, silt loam.	CL, CH	A-7	0	100	100	95-100	80-100	40-55	15-30

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
179D------------- Gara	0-13	Loam-------------	CL, CL-ML	A-4, A-6	0	95-100	85-95	75-85	55-70	20-30	5-15
	13-42	Clay loam, clay	CL, CH	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	42-60	Loam, clay loam	CL	A-6, A-7	0-5	90-95	85-95	70-85	55-75	35-45	15-25
179D2------------ Gara	0-8	Clay loam--------	CL	A-6, A-7	0	90-95	85-95	70-85	55-75	35-45	15-25
	8-46	Clay loam, clay	CL, CH	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	46-60	Loam, clay loam	CL	A-6, A-7	0-5	90-95	85-95	70-85	55-75	35-45	15-25
179E------------- Gara	0-12	Loam-------------	CL, CL-ML	A-4, A-6	0	95-100	85-95	75-85	55-70	20-30	5-15
	12-45	Clay loam, clay	CL, CH	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	45-60	Loam, clay loam	CL	A-6, A-7	0-5	90-95	85-95	70-85	55-75	35-45	15-25
179E2------------ Gara	0-7	Clay loam--------	CL	A-6, A-7	0	90-95	85-95	70-85	55-75	35-45	15-25
	7-41	Clay loam, clay	CL, CH	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	41-60	Loam, clay loam	CL	A-6, A-7	0-5	90-95	85-95	70-85	55-75	35-45	15-25
179E3------------ Gara	0-6	Clay loam--------	CL	A-6, A-7	0	90-95	85-95	70-85	55-75	35-45	15-25
	6-41	Clay loam, clay	CL, CH	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	41-60	Loam, clay loam	CL	A-6, A-7	0-5	90-95	85-95	70-85	55-75	35-45	15-25
179F------------- Gara	0-10	Loam-------------	CL, CL-ML	A-4, A-6	0	95-100	85-95	75-85	55-70	20-30	5-15
	10-46	Clay loam, clay	CL, CH	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	46-60	Loam, clay loam	CL	A-6, A-7	0-5	90-95	85-95	70-85	55-75	35-45	15-25
179F2------------ Gara	0-7	Clay loam--------	CL	A-6, A-7	0	90-95	85-95	70-85	55-75	35-45	15-25
	7-51	Clay loam, clay	CL, CH	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	51-60	Loam, clay loam	CL	A-6, A-7	0-5	90-95	85-95	70-85	55-75	35-45	15-25
192C------------- Adair	0-8	Loam-------------	CL, CL-ML	A-6, A-4	0	95-100	95-100	90-100	85-100	20-35	5-15
	8-42	Silty clay, clay, clay loam.	CL, CH	A-7	0	95-100	80-95	70-90	55-80	40-55	20-30
	42-60	Clay loam--------	CL	A-6, A-7	0	95-100	80-95	70-90	55-80	35-50	15-25
192C2------------ Adair	0-8	Clay loam--------	CL	A-6	0	95-100	80-95	75-90	60-80	30-40	10-20
	8-42	Silty clay, clay, clay loam.	CL, CH	A-7	0	95-100	80-95	70-90	55-80	40-55	20-30
	42-60	Clay loam--------	CL	A-6, A-7	0	95-100	80-95	70-90	55-80	35-50	15-25
192D------------- Adair	0-8	Loam-------------	CL, CL-ML	A-6, A-4	0	95-100	95-100	90-100	85-100	20-35	5-15
	8-42	Silty clay, clay, clay loam.	CL, CH	A-7	0	95-100	80-95	70-90	55-80	40-55	20-30
	42-60	Clay loam--------	CL	A-6, A-7	0	95-100	80-95	70-90	55-80	35-50	15-25
192D2------------ Adair	0-8	Clay loam--------	CL	A-6	0	95-100	80-95	75-90	60-80	30-40	10-20
	8-42	Silty clay, clay, clay loam.	CL, CH	A-7	0	95-100	80-95	70-90	55-80	40-55	20-30
	42-60	Clay loam--------	CL	A-6, A-7	0	95-100	80-95	70-90	55-80	35-50	15-25
192D3------------ Adair	0-7	Clay loam--------	CL	A-6	0	95-100	80-95	75-90	60-80	30-40	10-20
	7-42	Silty clay, clay, clay loam.	CL, CH	A-7	0	95-100	80-95	70-90	55-80	40-55	20-30
	42-60	Clay loam--------	CL	A-6, A-7	0	95-100	80-95	70-90	55-80	35-50	15-25
211-------------- Edina	0-18	Silt loam, silty clay loam.	CL-ML, CL	A-4, A-6	0	100	100	95-100	85-100	25-40	5-15
	18-48	Silty clay-------	CH	A-7	0	100	100	95-100	90-100	55-75	30-45
	48-60	Silty clay loam	CL, CH	A-6, A-7	0	100	100	95-100	90-100	35-60	15-35
220-------------- Nodaway	0-9	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-35	5-15
	9-60	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-40	5-15

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
222C, 222C2------ Clarinda	0-9	Silty clay loam	CL	A-7	0	100	95-100	90-100	85-100	40-50	20-30
	9-42	Silty clay, clay	CH	A-7	0	100	95-100	85-100	80-100	55-70	30-40
	42-60	Clay, silty clay	CH	A-7	0	95-100	95-100	80-95	75-90	55-70	35-45
222C3----------- Clarinda	0-4	Silty clay-------	CH	A-7	0	100	95-100	85-100	80-100	55-70	30-40
	4-39	Silty clay, clay	CH	A-7	0	100	95-100	85-100	80-100	55-70	30-40
	39-60	Clay, silty clay	CH	A-7	0	95-100	95-100	80-95	75-90	55-70	35-45
222D2----------- Clarinda	0-7	Silty clay loam	CL	A-7	0	100	95-100	90-100	85-100	40-50	20-30
	7-43	Silty clay, clay	CH	A-7	0	100	95-100	85-100	80-100	55-70	30-40
	43-60	Clay, silty clay	CH	A-7	0	95-100	95-100	80-95	75-90	55-70	35-45
269-------------- Humeston	0-16	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
	16-28	Silt loam--------	CL, CL-ML	A-6, A-4	0	100	100	95-100	95-100	25-40	5-15
	28-60	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	95-100	95-100	45-55	25-35
273B, 273C------- Olmitz	0-9	Loam-------------	CL	A-6	0	100	90-100	85-95	60-80	30-40	11-20
	9-31	Loam, clay loam	CL	A-6	0	100	90-100	85-95	60-80	30-40	11-20
	31-60	Clay loam--------	CL	A-6, A-7	0	100	90-100	85-95	60-80	35-45	15-25
362-------------- Haig	0-7	Silt loam--------	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
	7-19	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	100	95-100	40-55	20-30
	19-41	Silty clay-------	CH	A-7	0	100	100	100	95-100	50-65	30-40
	41-60	Silty clay loam	CL, CH	A-7, A-6	0	100	100	100	95-100	35-55	20-30
364B------------ Grundy	0-12	Silty clay loam	CH, CL	A-7	0	100	100	95-100	90-100	40-55	20-35
	12-15	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
368, 368B-------- Macksburg	0-19	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	19-30	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-60	20-35
	30-45	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
	45-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-50	20-30
369-------------- Winterset	0-19	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	20-30
	19-40	Silty clay, silty clay loam.	CH	A-7	0	100	100	100	95-100	50-70	30-40
	40-60	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	45-55	25-35
370B, 370C, 370C2----------- Sharpsburg	0-19	Silty clay loam	CL, CH	A-7, A-6	0	100	100	100	95-100	35-55	18-32
	19-34	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-60	20-35
	34-51	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
	51-60	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
423C2, 423D, 423D2----------- Bucknell	0-7	Silty clay loam	CL	A-6, A-7	0	95-100	95-100	80-95	70-95	35-45	15-25
	7-46	Clay, clay loam, silty clay loam.	CH	A-7	0	95-100	95-100	90-100	85-100	50-60	25-35
	46-60	Clay loam--------	CL	A-6, A-7	0	95-100	95-100	70-90	55-85	35-50	15-30
425D------------- Keswick	0-14	Loam-------------	CL, CL-ML	A-6, A-4	0-5	90-100	80-100	75-90	60-80	20-30	5-15
	14-39	Clay loam, clay	MH	A-7	0-5	90-100	80-100	70-90	55-80	50-70	20-35
	39-60	Clay loam--------	CL	A-6	0-5	90-100	80-100	70-90	55-80	30-40	15-25

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
425D2------------ Keswick	0-5	Clay loam--------	CL	A-6, A-7	0-5	90-100	80-100	75-90	60-80	35-50	15-25
	5-36	Clay loam, clay	MH	A-7	0-5	90-100	80-100	70-90	55-80	50-70	20-35
	36-60	Clay loam--------	CL	A-6	0-5	90-100	80-100	70-90	55-80	30-40	15-25
430-------------- Ackmore	0-8	Silt loam--------	CL, ML	A-4, A-6, A-7	0	100	100	95-100	85-100	25-50	8-20
	8-25	Silt loam, silty clay loam.	CL, ML	A-4, A-6, A-7	0	100	100	95-100	85-100	25-50	8-20
	25-60	Silty clay loam, silt loam.	CH, CL	A-7, A-6	0	100	100	95-100	85-100	35-60	15-30
452C2------------ Lineville	0-7	Silt loam--------	CL, ML	A-6, A-7	0	100	100	95-100	95-100	35-45	10-20
	7-19	Silty clay loam	CL, CH	A-7	0	100	100	95-100	95-100	45-55	25-35
	19-45	Clay loam, loam	CL	A-6, A-7	0	95-100	80-100	75-95	65-90	35-50	20-35
	45-60	Clay loam, clay	CH, CL	A-7	0-5	95-100	80-100	70-90	55-80	45-60	25-35
484-------------- Lawson	0-19	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	85-100	20-40	5-20
	19-30	Silt loam, silty clay loam.	CL, CL-ML	A-4	0	100	100	90-100	85-100	20-30	5-10
	30-60	Loam, silt loam	CL	A-6, A-7	0	100	100	90-100	60-100	20-45	10-25
570C, 570C2------ Nira	0-12	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	15-25
	12-48	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	20-30
	48-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
592C2, 592D2----- Mystic	0-7	Clay loam--------	CL	A-6, A-7	0	100	100	80-100	65-90	30-45	10-25
	7-46	Clay loam, clay, silty clay.	CL, CH	A-7	0	100	90-100	80-100	65-80	40-55	25-35
	46-60	Sandy clay loam, loam, clay loam.	SC, CL, SM-SC, CL-ML	A-6, A-4	0-5	90-100	80-100	70-95	40-65	25-40	5-20
730C*:											
Cantril---------	0-10	Loam-------------	CL	A-6	0	100	100	85-95	65-75	30-40	11-20
	10-60	Clay loam--------	CL	A-6, A-7	0	100	100	90-100	70-88	35-45	15-25
Nodaway---------	0-9	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-35	5-15
	9-60	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-40	5-15
792C------------- Armstrong	0-12	Loam-------------	CL, CL-ML	A-6, A-4	0-5	90-100	80-95	75-90	55-80	20-30	5-15
	12-53	Clay loam, clay, silty clay loam.	CL, CH, ML, MH	A-7	0-5	90-100	80-95	70-90	55-80	45-70	20-35
	53-60	Clay loam--------	CL	A-6	0-5	90-100	80-95	70-90	55-80	30-40	15-20
792C2------------ Armstrong	0-7	Clay loam--------	CL	A-6, A-7	0-5	90-100	80-95	75-90	55-80	35-45	15-25
	7-48	Clay loam, clay, silty clay loam.	CL, CH, ML, MH	A-7	0-5	90-100	80-95	70-90	55-80	45-70	20-35
	48-60	Clay loam--------	CL	A-6	0-5	90-100	80-95	70-90	55-80	30-40	15-20
792D------------- Armstrong	0-12	Loam-------------	CL, CL-ML	A-6, A-4	0-5	90-100	80-95	75-90	55-80	20-30	5-15
	12-40	Clay loam, clay, silty clay loam.	CL, CH, ML, MH	A-7	0-5	90-100	80-95	70-90	55-80	45-70	20-35
	40-60	Clay loam--------	CL	A-6	0-5	90-100	80-95	70-90	55-80	30-40	15-20
792D2, 792D3----- Armstrong	0-7	Clay loam--------	CL	A-6, A-7	0-5	90-100	80-95	75-90	55-80	35-45	15-25
	7-48	Clay loam, clay, silty clay loam.	CL, CH, ML, MH	A-7	0-5	90-100	80-95	70-90	55-80	45-70	20-35
	48-60	Clay loam--------	CL	A-6	0-5	90-100	80-95	70-90	55-80	30-40	15-20

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
822C, 822C2, 822C3, 822D, 822D2, 822D3---- Lamoni	0-14	Clay loam--------	CL	A-6, A-7	0	95-100	95-100	80-95	70-95	35-45	15-25
	14-52	Clay loam, clay	CH	A-7	0	95-100	95-100	90-100	85-100	50-60	25-35
	52-60	Clay loam--------	CL	A-6, A-7	0	95-100	95-100	70-90	55-85	35-50	15-30
892C2------------ Mystic Variant	0-8	Silty clay loam	CL	A-7	0	100	95-100	90-100	85-100	40-50	20-30
	8-31	Silty clay, clay	CH	A-7	0	95-100	95-100	85-95	75-90	55-70	35-45
	31-60	Clay loam, silty clay loam.	CL	A-6, A-7	0	95-100	80-95	70-90	55-80	35-45	15-25
993D2*, 993E2*: Gara------------	0-8	Clay loam--------	CL	A-6, A-7	0	90-95	85-95	70-85	55-75	35-45	15-25
	8-46	Clay loam, loam	CL	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	46-60	Loam, clay loam	CL	A-6, A-7	0-5	90-95	85-95	70-85	55-75	35-45	15-25
Armstrong--------	0-7	Clay loam--------	CL	A-6, A-7	0-5	90-100	80-95	75-90	55-80	35-45	15-25
	7-50	Clay loam, clay, silty clay loam.	CL, CH, ML, MH	A-7	0-5	90-100	80-95	70-90	55-80	45-70	20-35
	50-60	Clay loam--------	CL	A-6	0-5	90-100	80-95	70-90	55-80	30-40	15-20
1715*: Nodaway----------	0-9	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-35	5-15
	9-60	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-40	5-15
Lawson-----------	0-19	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	85-100	20-40	5-20
	19-30	Silt loam, silty clay loam.	CL, CL-ML	A-4	0	100	100	90-100	85-100	20-30	5-10
	30-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	90-100	60-100	20-45	10-25
5030*. Pits											
5040*. Orthents											

* 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" 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 K	Erosion factors T	Wind erodibility group
	In	Pct	g/cc	In/hr	In/in	pH				
13B*:										
Olmitz	0-9	24-27	1.40-1.45	0.6-2.0	0.19-0.21	5.6-7.3	Moderate	0.28	5	6
	9-31	24-30	1.40-1.45	0.6-2.0	0.19-0.21	5.6-7.3	Moderate	0.28		
	31-60	28-34	1.45-1.55	0.6-2.0	0.15-0.17	5.1-7.3	Moderate	0.28		
Zook	0-19	32-38	1.30-1.35	0.2-0.6	0.21-0.23	5.6-7.3	High	0.28	5	7
	19-60	36-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.8	High	0.28		
Colo	0-9	27-32	1.28-1.32	0.6-2.0	0.21-0.23	5.6-7.3	Moderate	0.28	5	7
	9-35	30-35	1.25-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate	0.28		
	35-60	25-35	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	Moderate	0.28		
23C, 23C2 Arispe	0-13	27-38	1.35-1.40	0.6-2.0	0.21-0.23	5.6-7.3	High	0.32	5	7
	13-42	35-42	1.35-1.45	0.2-0.6	0.18-0.20	5.6-7.3	High	0.43		
	42-60	24-35	1.40-1.50	0.6-2.0	0.18-0.20	6.1-7.3	High	0.43		
24D Shelby	0-9	24-27	1.50-1.55	0.6-2.0	0.20-0.22	5.1-7.3	Moderate	0.28	5	6
	9-47	30-38	1.55-1.65	0.2-0.6	0.16-0.18	5.1-7.3	Moderate	0.28		
	47-60	30-35	1.55-1.65	0.2-0.6	0.16-0.18	6.6-8.4	Moderate	0.37		
24D2 Shelby	0-8	27-35	1.50-1.55	0.2-0.6	0.16-0.18	5.1-7.3	Moderate	0.28	5	6
	8-42	30-38	1.55-1.65	0.2-0.6	0.16-0.18	5.1-7.3	Moderate	0.28		
	42-60	30-35	1.55-1.65	0.2-0.6	0.16-0.18	6.6-8.4	Moderate	0.37		
24E Shelby	0-9	24-27	1.50-1.55	0.6-2.0	0.20-0.22	5.1-7.3	Moderate	0.28	5	6
	9-47	30-38	1.55-1.65	0.2-0.6	0.16-0.18	5.1-7.3	Moderate	0.28		
	47-60	30-35	1.55-1.65	0.2-0.6	0.16-0.18	6.6-8.4	Moderate	0.37		
24E2 Shelby	0-8	27-35	1.50-1.55	0.2-0.6	0.16-0.18	5.1-7.3	Moderate	0.28	5	6
	8-42	30-38	1.55-1.65	0.2-0.6	0.16-0.18	5.1-7.3	Moderate	0.28		
	42-60	30-35	1.55-1.65	0.2-0.6	0.16-0.18	6.6-8.4	Moderate	0.37		
24E3 Shelby	0-8	27-35	1.50-1.55	0.2-0.6	0.16-0.18	5.1-7.3	Moderate	0.28	4	6
	8-32	30-38	1.55-1.65	0.2-0.6	0.16-0.18	5.1-7.3	Moderate	0.28		
	32-60	30-35	1.55-1.65	0.2-0.6	0.16-0.18	6.6-8.4	Moderate	0.37		
24F Shelby	0-10	24-27	1.50-1.55	0.6-2.0	0.20-0.22	5.1-7.3	Moderate	0.28	5	6
	10-40	30-38	1.55-1.65	0.2-0.6	0.16-0.18	5.1-7.3	Moderate	0.28		
	40-60	30-35	1.55-1.65	0.2-0.6	0.16-0.18	6.6-8.4	Moderate	0.37		
24F2 Shelby	0-8	27-35	1.50-1.55	0.2-0.6	0.16-0.18	5.1-7.3	Moderate	0.28	5	6
	8-32	30-38	1.55-1.65	0.2-0.6	0.16-0.18	5.1-7.3	Moderate	0.28		
	32-60	30-35	1.55-1.65	0.2-0.6	0.16-0.18	6.6-8.4	Moderate	0.37		
51, 51B Vesser	0-13	20-26	1.30-1.35	0.6-2.0	0.20-0.24	5.6-7.3	Moderate	0.32	5	6
	13-32	18-22	1.35-1.40	0.6-2.0	0.18-0.22	5.1-6.0	Moderate	0.43		
	32-60	30-38	1.40-1.45	0.6-2.0	0.17-0.21	5.1-6.5	Moderate	0.43		
54 Zook	0-19	32-38	1.30-1.35	0.2-0.6	0.21-0.23	5.6-7.3	High	0.28	5	7
	19-60	36-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.8	High	0.28		
54+ Zook	0-18	20-26	1.30-1.35	0.6-2.0	0.22-0.24	5.6-7.3	Moderate	0.28	5	6
	18-25	36-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.8	High	0.28		
	25-60	20-45	1.30-1.45	0.06-0.6	0.11-0.22	5.6-7.8	High	0.28		

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
	In	Pct	g/cc	In/hr	In/in	pH				
56C-------------- Cantril	0-10	14-27	1.40-1.45	0.6-2.0	0.17-0.19	5.1-7.3	Low-----------	0.32	5	6
	10-60	27-35	1.45-1.75	0.6-2.0	0.14-0.16	5.1-6.5	Moderate-----	0.32		
65D, 65E, 65F---- Lindley	0-11	18-27	1.20-1.40	0.6-2.0	0.16-0.18	4.5-7.3	Low-----------	0.32	5	6
	11-39	28-42	1.40-1.60	0.2-0.6	0.14-0.18	4.5-6.5	Moderate-----	0.32		
	39-60	18-32	1.45-1.65	0.2-0.6	0.12-0.16	6.1-7.8	Moderate-----	0.32		
65F2------------- Lindley	0-6	27-35	1.30-1.40	0.2-0.6	0.14-0.18	4.5-7.3	Moderate-----	0.32	5	6
	6-40	28-42	1.40-1.60	0.2-0.6	0.14-0.18	4.5-6.5	Moderate-----	0.32		
	40-60	18-32	1.45-1.65	0.2-0.6	0.12-0.16	6.1-7.8	Moderate-----	0.32		
65G-------------- Lindley	0-11	18-27	1.20-1.40	0.6-2.0	0.16-0.18	4.5-7.3	Low-----------	0.32	5	6
	11-39	28-42	1.40-1.60	0.2-0.6	0.14-0.18	4.5-6.5	Moderate-----	0.32		
	39-60	18-32	1.45-1.65	0.2-0.6	0.12-0.16	6.1-7.8	Moderate-----	0.32		
69C, 69C2-------- Clearfield	0-12	32-38	1.30-1.40	0.2-0.6	0.21-0.23	5.6-7.3	High----------	0.28	5	4
	12-50	35-42	1.30-1.45	0.2-0.6	0.18-0.20	5.6-7.3	High----------	0.43		
	50-60	40-50	1.40-1.65	<0.06	0.10-0.12	5.6-7.3	High----------	0.43		
76C2------------- Ladoga	0-7	27-35	1.30-1.35	0.6-2.0	0.22-0.24	6.1-7.3	Low-----------	0.32	5	7
	7-54	36-42	1.30-1.40	0.2-0.6	0.18-0.20	5.1-6.5	Moderate-----	0.43		
	54-60	24-32	1.35-1.45	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.43		
87B*:										
Zook-------------	0-19	32-38	1.30-1.35	0.2-0.6	0.21-0.23	5.6-7.3	High----------	0.28	5	7
	19-60	36-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.8	High----------	0.28		
Colo-------------	0-9	27-32	1.28-1.32	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7
	9-35	30-35	1.25-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.28		
	35-60	25-35	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.28		
93D*:										
Shelby-----------	0-9	24-27	1.50-1.55	0.6-2.0	0.20-0.22	5.1-7.3	Moderate-----	0.28	5	6
	9-47	30-38	1.55-1.65	0.2-0.6	0.16-0.18	5.1-7.3	Moderate-----	0.28		
	47-60	30-35	1.55-1.65	0.2-0.6	0.16-0.18	6.6-8.4	Moderate-----	0.37		
Adair------------	0-8	24-27	1.45-1.50	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.32	3	6
	8-42	38-60	1.50-1.60	0.06-0.2	0.13-0.16	5.1-6.5	High----------	0.32		
	42-60	30-38	1.60-1.70	0.2-0.6	0.14-0.16	5.6-7.8	Moderate-----	0.32		
93D2*, 93D3*:										
Shelby-----------	0-8	27-35	1.50-1.55	0.2-0.6	0.16-0.18	5.1-7.3	Moderate-----	0.28	5-4	6
	8-42	30-38	1.55-1.65	0.2-0.6	0.16-0.18	5.1-7.3	Moderate-----	0.28		
	42-60	30-35	1.55-1.65	0.2-0.6	0.16-0.18	6.6-8.4	Moderate-----	0.37		
Adair------------	0-8	27-35	1.45-1.50	0.2-0.6	0.17-0.19	5.6-7.3	Moderate-----	0.32	3-2	6
	8-42	38-60	1.50-1.60	0.06-0.2	0.13-0.16	5.1-6.5	High----------	0.32		
	42-60	30-38	1.60-1.70	0.2-0.6	0.14-0.16	5.6-7.8	Moderate-----	0.32		
94D*:										
Caleb------------	0-12	22-27	1.45-1.50	0.6-2.0	0.14-0.18	4.5-7.3	Low-----------	0.28	5	6
	12-48	20-35	1.45-1.65	0.6-2.0	0.14-0.18	4.5-6.0	Moderate-----	0.28		
	48-60	5-30	1.55-1.75	0.6-2.0	0.12-0.16	6.1-6.5	Low-----------	0.28		
Mystic-----------	0-12	22-27	1.40-1.45	0.6-2.0	0.22-0.24	4.5-6.5	Moderate-----	0.37	3	6
	12-50	30-48	1.45-1.65	0.06-0.2	0.15-0.19	4.5-6.5	High----------	0.37		
	50-60	10-30	1.65-1.75	0.6-6.0	0.11-0.13	6.1-7.3	Low-----------	0.24		

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		Wind erodibility group
								K	T	
	In	Pct	g/cc	In/hr	In/in	pH				
94D2*, 94E2*:										
Caleb-----------	0-7	22-27	1.45-1.50	0.6-2.0	0.14-0.18	4.5-7.3	Low-----------	0.28	5	6
	7-46	20-35	1.45-1.65	0.6-2.0	0.14-0.18	4.5-6.0	Moderate-----	0.28		
	46-60	5-30	1.55-1.75	0.6-2.0	0.12-0.16	5.6-6.5	Low-----------	0.28		
Mystic----------	0-7	27-32	1.40-1.45	0.6-2.0	0.22-0.24	4.5-6.5	Moderate-----	0.37	3	6
	7-50	30-48	1.45-1.65	0.06-0.2	0.15-0.19	4.5-6.5	High---------	0.37		
	50-60	10-30	1.65-1.75	0.6-6.0	0.11-0.13	6.1-7.3	Low-----------	0.24		
131B, 131C------- Pershing	0-7	20-27	1.30-1.40	0.6-2.0	0.22-0.24	4.5-7.3	Low-----------	0.37	3	6
	7-12	27-35	1.30-1.40	0.2-0.6	0.20-0.22	5.1-6.0	Moderate-----	0.37		
	12-38	35-48	1.35-1.45	0.06-0.2	0.18-0.20	5.1-6.0	High---------	0.37		
	38-60	24-40	1.35-1.50	0.2-0.6	0.18-0.20	5.1-6.5	High---------	0.37		
131C2----------- Pershing	0-7	27-38	1.30-1.40	0.2-0.6	0.22-0.24	4.5-7.3	Moderate-----	0.37	3	7
	7-11	27-35	1.30-1.40	0.2-0.6	0.20-0.22	5.1-6.0	Moderate-----	0.37		
	11-32	35-48	1.35-1.45	0.06-0.2	0.18-0.20	5.1-6.0	High---------	0.37		
	32-60	24-40	1.35-1.50	0.2-0.6	0.18-0.20	5.1-6.5	High---------	0.37		
132C------------ Weller	0-13	16-27	1.35-1.45	0.6-2.0	0.22-0.24	4.5-7.3	Low-----------	0.43	3	6
	13-39	28-48	1.35-1.50	0.06-0.2	0.12-0.18	4.5-6.0	High---------	0.43		
	39-60	25-40	1.40-1.55	0.2-0.6	0.18-0.20	5.1-6.0	High---------	0.43		
133, 133B-------- Colo	0-9	27-32	1.28-1.32	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7
	9-35	30-35	1.25-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.28		
	35-60	25-35	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.28		
179D------------ Gara	0-13	24-27	1.50-1.55	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.28	5	6
	13-42	30-38	1.55-1.75	0.2-0.6	0.16-0.18	4.5-7.8	Moderate-----	0.28		
	42-60	24-38	1.65-1.75	0.2-0.6	0.16-0.18	6.6-8.4	Moderate-----	0.37		
179D2----------- Gara	0-8	27-35	1.50-1.55	0.2-0.6	0.16-0.18	5.6-7.3	Moderate-----	0.28	5	6
	8-46	30-38	1.55-1.75	0.2-0.6	0.16-0.18	4.5-7.8	Moderate-----	0.28		
	46-60	24-38	1.65-1.75	0.2-0.6	0.16-0.18	6.6-8.4	Moderate-----	0.37		
179E------------ Gara	0-12	24-27	1.50-1.55	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.28	5	6
	12-45	30-38	1.55-1.75	0.2-0.6	0.16-0.18	4.5-7.8	Moderate-----	0.28		
	45-60	24-38	1.65-1.75	0.2-0.6	0.16-0.18	6.6-8.4	Moderate-----	0.37		
179E2----------- Gara	0-7	27-35	1.50-1.55	0.2-0.6	0.16-0.18	5.6-7.3	Moderate-----	0.28	5	6
	7-41	30-38	1.55-1.75	0.2-0.6	0.16-0.18	4.5-7.8	Moderate-----	0.28		
	41-60	24-38	1.65-1.75	0.2-0.6	0.16-0.18	6.6-8.4	Moderate-----	0.37		
179E3----------- Gara	0-6	27-35	1.50-1.55	0.2-0.6	0.16-0.18	5.6-7.3	Moderate-----	0.28	4	6
	6-41	30-38	1.55-1.75	0.2-0.6	0.16-0.18	4.5-7.8	Moderate-----	0.28		
	41-60	24-38	1.65-1.75	0.2-0.6	0.16-0.18	6.6-8.4	Moderate-----	0.37		
179F------------ Gara	0-10	21-27	1.50-1.55	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.28	5	6
	10-46	30-42	1.55-1.75	0.2-0.6	0.16-0.18	4.5-7.8	Moderate-----	0.28		
	46-60	24-38	1.65-1.75	0.2-0.6	0.16-0.18	6.6-8.4	Moderate-----	0.37		
179F2----------- Gara	0-7	27-35	1.50-1.55	0.2-0.6	0.16-0.18	5.6-7.3	Moderate-----	0.28	5	6
	7-51	30-38	1.55-1.75	0.2-0.6	0.16-0.18	4.5-7.8	Moderate-----	0.28		
	51-60	24-38	1.65-1.75	0.2-0.6	0.16-0.18	6.6-8.4	Moderate-----	0.37		
192C------------ Adair	0-8	24-27	1.45-1.50	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.32	3	6
	8-42	38-60	1.50-1.60	0.06-0.2	0.13-0.16	5.1-6.5	High---------	0.32		
	42-60	30-38	1.60-1.70	0.2-0.6	0.14-0.16	5.6-7.8	Moderate-----	0.32		

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
	In	Pct	g/cc	In/hr	In/in	pH				
192C2-----------	0-8	27-35	1.45-1.50	0.2-0.6	0.17-0.19	5.6-7.3	Moderate-----	0.32	3	6
Adair	8-42	38-60	1.50-1.60	0.06-0.2	0.13-0.16	5.1-6.5	High---------	0.32		
	42-60	30-38	1.60-1.70	0.2-0.6	0.14-0.16	5.6-7.8	Moderate-----	0.32		
192D------------	0-8	24-27	1.45-1.50	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.32	3	6
Adair	8-42	38-60	1.50-1.60	0.06-0.2	0.13-0.16	5.1-6.5	High---------	0.32		
	42-60	30-38	1.60-1.70	0.2-0.6	0.14-0.16	5.6-7.8	Moderate-----	0.32		
192D2-----------	0-8	27-35	1.45-1.50	0.2-0.6	0.17-0.19	5.6-7.3	Moderate-----	0.32	3	6
Adair	8-42	38-60	1.50-1.60	0.06-0.2	0.13-0.16	5.1-6.5	High---------	0.32		
	42-60	30-38	1.60-1.70	0.2-0.6	0.14-0.16	5.6-7.8	Moderate-----	0.32		
192D3-----------	0-7	27-35	1.45-1.50	0.2-0.6	0.17-0.19	5.6-7.3	Moderate-----	0.32	2	6
Adair	7-42	38-60	1.50-1.60	0.06-0.2	0.13-0.16	5.1-6.5	High---------	0.32		
	42-60	30-38	1.60-1.70	0.2-0.6	0.14-0.16	5.6-7.8	Moderate-----	0.32		
211-------------	0-18	15-31	1.35-1.45	0.6-2.0	0.22-0.24	5.1-7.3	Moderate-----	0.37	3	6
Edina	18-48	45-60	1.30-1.45	<0.06	0.11-0.13	5.6-7.3	Very high----	0.37		
	48-60	27-40	1.35-1.50	0.06-0.2	0.18-0.20	6.6-7.3	High---------	0.37		
220-------------	0-9	18-27	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Low----------	0.37	5	6
Nodaway	9-60	18-28	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Moderate-----	0.37		
222C, 222C2------	0-9	30-38	1.45-1.50	0.2-0.6	0.17-0.19	5.1-7.3	Moderate-----	0.37	3	7
Clarinda	9-42	40-60	1.45-1.60	<0.06	0.14-0.16	5.1-6.5	High---------	0.37		
	42-60	40-60	1.50-1.60	<0.06	0.14-0.16	5.6-8.4	High---------	0.37		
222C3-----------	0-4	40-50	1.45-1.55	<0.06	0.14-0.16	5.1-6.5	High---------	0.37	2	4
Clarinda	4-39	40-60	1.45-1.60	<0.06	0.14-0.16	5.1-6.5	High---------	0.37		
	39-60	40-60	1.50-1.60	<0.06	0.14-0.16	5.6-8.4	High---------	0.37		
222D2-----------	0-7	30-38	1.45-1.50	0.2-0.6	0.17-0.19	5.1-7.3	Moderate-----	0.37	3	7
Clarinda	7-43	40-60	1.45-1.60	<0.06	0.14-0.16	5.1-6.5	High---------	0.37		
	43-60	40-60	1.50-1.60	<0.06	0.14-0.16	5.6-8.4	High---------	0.37		
269-------------	0-16	24-27	1.35-1.40	0.6-2.0	0.21-0.23	5.1-7.3	Low----------	0.32	4	6
Humeston	16-28	20-26	1.30-1.35	0.2-2.0	0.20-0.22	4.5-6.0	Moderate-----	0.32		
	28-60	30-48	1.35-1.50	<0.06	0.13-0.15	4.5-6.5	High---------	0.32		
273B, 273C-------	0-9	24-27	1.40-1.45	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.28	5	6
Olmitz	9-31	24-30	1.40-1.45	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.28		
	31-60	28-34	1.45-1.55	0.6-2.0	0.15-0.17	5.1-7.3	Moderate-----	0.28		
362-------------	0-7	22-27	1.35-1.40	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.37	3	6
Haig	7-19	28-48	1.30-1.35	0.6-2.0	0.21-0.23	5.1-6.0	High---------	0.37		
	19-41	40-50	1.30-1.45	0.06-0.2	0.12-0.14	5.1-6.0	High---------	0.37		
	41-60	28-40	1.40-1.50	0.2-0.6	0.18-0.20	6.1-7.3	High---------	0.37		
364B------------	0-12	28-35	1.35-1.45	0.2-0.6	0.18-0.20	5.6-7.3	High---------	0.37	3	6
Grundy	12-15	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		
368, 368B--------	0-19	27-34	1.30-1.35	0.6-2.0	0.21-0.23	5.1-7.3	Moderate-----	0.32	5	7
Macksburg	19-30	36-42	1.35-1.40	0.2-0.6	0.18-0.20	5.1-6.0	High---------	0.43		
	30-45	30-38	1.40-1.45	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.43		
	45-60	25-32	1.40-1.45	0.6-2.0	0.18-0.20	5.6-6.5	Moderate-----	0.43		
369-------------	0-19	27-35	1.30-1.35	0.2-0.6	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7
Winterset	19-40	38-42	1.35-1.40	0.2-0.6	0.14-0.18	5.6-6.5	High---------	0.43		
	40-60	27-40	1.40-1.45	0.2-0.6	0.18-0.20	6.1-7.3	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
	In	Pct	g/cc	In/hr	In/in	pH				
370B, 370C, 370C2----------- Sharpsburg	0-19	27-34	1.30-1.35	0.6-2.0	0.21-0.23	5.1-6.5	Moderate-----	0.32	5	7
	19-34	36-42	1.35-1.40	0.2-0.6	0.18-0.20	5.1-6.0	Moderate-----	0.43		
	34-51	30-38	1.40-1.45	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.43		
	51-60	25-34	1.40-1.45	0.6-2.0	0.18-0.20	6.1-6.5	Moderate-----	0.43		
423C2, 423D, 423D2----------- Bucknell	0-7	27-38	1.45-1.50	0.2-0.6	0.17-0.21	5.1-7.3	Moderate-----	0.32	3	6
	7-46	38-50	1.55-1.65	<0.2	0.13-0.17	4.5-6.5	High---------	0.32		
	46-60	30-40	1.60-1.70	0.06-0.2	0.14-0.18	5.6-7.3	High---------	0.32		
425D------------- Keswick	0-14	20-27	1.45-1.50	0.6-2.0	0.17-0.22	4.5-7.3	Moderate-----	0.37	3	6
	14-39	35-60	1.45-1.60	0.06-0.2	0.11-0.15	4.5-6.0	High---------	0.37		
	39-60	30-40	1.60-1.75	0.2-0.6	0.12-0.16	4.5-7.8	Moderate-----	0.37		
425D2------------ Keswick	0-5	27-40	1.45-1.50	0.2-0.6	0.17-0.19	4.5-7.3	Moderate-----	0.37	3	4
	5-36	35-60	1.45-1.60	0.06-0.2	0.11-0.15	4.5-6.0	High---------	0.37		
	36-60	30-40	1.60-1.75	0.2-0.6	0.12-0.16	4.5-7.8	Moderate-----	0.37		
430-------------- Ackmore	0-8	23-27	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.37	5	6
	8-25	25-30	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.37		
	25-60	26-38	1.30-1.40	0.6-2.0	0.18-0.20	5.6-7.8	High---------	0.37		
452C2------------ Lineville	0-7	22-27	1.45-1.50	0.6-2.0	0.16-0.20	5.1-7.3	Moderate-----	0.37	5	6
	7-19	28-35	1.50-1.55	0.2-0.6	0.17-0.21	5.1-6.5	Moderate-----	0.37		
	19-45	20-35	1.65-1.75	0.06-0.2	0.17-0.21	5.6-6.5	Moderate-----	0.37		
	45-60	28-45	1.65-1.75	0.06-0.2	0.13-0.21	5.6-7.3	High---------	0.37		
484-------------- Lawson	0-19	10-27	1.20-1.55	0.6-2.0	0.22-0.24	6.1-7.8	Low----------	0.28	5	5
	19-30	10-30	1.20-1.55	0.6-2.0	0.18-0.22	6.1-7.8	Low----------	0.28		
	30-60	18-27	1.55-1.65	0.6-2.0	0.18-0.20	6.1-7.8	Moderate-----	0.43		
570C, 570C2------ Nira	0-12	28-34	1.25-1.40	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	7
	12-48	30-38	1.25-1.40	0.6-2.0	0.18-0.20	5.1-6.0	Moderate-----	0.43		
	48-60	24-34	1.35-1.45	0.6-2.0	0.18-0.20	5.6-6.5	Moderate-----	0.43		
592C2, 592D2----- Mystic	0-7	27-32	1.40-1.45	0.6-2.0	0.22-0.24	4.5-6.5	Moderate-----	0.37	3	6
	7-46	30-48	1.45-1.65	0.06-0.2	0.15-0.19	4.5-6.5	High---------	0.37		
	46-60	20-35	1.65-1.75	0.6-2.0	0.16-0.18	6.1-7.3	Moderate-----	0.37		
730C*:										
Cantril---------	0-10	14-27	1.40-1.45	0.6-2.0	0.17-0.19	5.1-7.3	Low----------	0.32	5	6
	10-60	27-35	1.45-1.75	0.6-2.0	0.14-0.16	5.1-6.5	Moderate-----	0.32		
Nodaway---------	0-9	18-27	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Low----------	0.37	5	6
	9-60	18-28	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Moderate-----	0.37		
792C------------- Armstrong	0-12	22-27	1.45-1.50	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.32	3	6
	12-53	36-60	1.45-1.55	0.06-0.2	0.11-0.16	4.5-6.5	High---------	0.32		
	53-60	30-36	1.55-1.70	0.2-0.6	0.14-0.16	5.1-7.8	Moderate-----	0.32		
792C2------------ Armstrong	0-7	27-38	1.45-1.50	0.2-0.6	0.18-0.20	5.6-7.3	Moderate-----	0.32	3	6
	7-48	36-60	1.45-1.55	0.06-0.2	0.11-0.16	4.5-6.5	High---------	0.32		
	48-60	30-36	1.55-1.70	0.2-0.6	0.14-0.16	5.1-7.8	Moderate-----	0.32		
792D------------- Armstrong	0-12	22-27	1.45-1.50	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.32	3	6
	12-40	36-60	1.45-1.55	0.06-0.2	0.11-0.16	4.5-6.5	High---------	0.32		
	40-60	30-36	1.55-1.70	0.2-0.6	0.14-0.16	5.1-7.8	Moderate-----	0.32		

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
	In	Pct	g/cc	In/hr	In/in	pH				
792D2, 792D3----- Armstrong	0-7	27-38	1.45-1.50	0.2-0.6	0.18-0.20	5.6-7.3	Moderate-----	0.32	3-2	6
	7-48	36-60	1.45-1.55	0.06-0.2	0.11-0.16	4.5-6.5	High---------	0.32		
	48-60	30-36	1.55-1.70	0.2-0.6	0.14-0.16	5.1-7.8	Moderate-----	0.32		
822C, 822C2, 822C3, 822D, 822D2, 822D3---- Lamoni	0-14	27-40	1.45-1.50	0.2-0.6	0.17-0.21	5.1-7.3	Moderate-----	0.32	3-2	6
	14-52	38-50	1.55-1.65	0.06-0.2	0.13-0.17	5.1-6.5	High---------	0.32		
	52-60	32-40	1.60-1.70	0.06-0.2	0.14-0.18	5.6-7.3	High---------	0.32		
892C2----------- Mystic Variant	0-8	30-35	1.45-1.50	0.2-0.6	0.20-0.22	5.1-6.5	Moderate-----	0.43	3	7
	8-31	40-50	1.45-1.65	<0.06	0.14-0.16	5.1-6.5	High---------	0.43		
	31-60	30-40	1.55-1.75	0.2-0.6	0.18-0.20	5.1-7.3	Moderate-----	0.43		
993D2*, 993E2*: Gara------------	0-8	27-35	1.50-1.55	0.2-0.6	0.16-0.18	5.6-7.3	Moderate-----	0.28	5	6
	8-46	25-38	1.55-1.75	0.2-0.6	0.16-0.18	4.5-6.5	Moderate-----	0.28		
	46-60	24-38	1.65-1.75	0.2-0.6	0.16-0.18	6.6-8.4	Moderate-----	0.37		
Armstrong-------	0-7	27-38	1.45-1.50	0.2-0.6	0.18-0.20	5.6-7.3	Moderate-----	0.32	3	6
	7-50	36-60	1.45-1.55	0.06-0.2	0.11-0.16	4.5-6.5	High---------	0.32		
	50-60	30-36	1.55-1.70	0.2-0.6	0.14-0.16	5.1-7.8	Moderate-----	0.32		
1715*: Nodaway---------	0-9	18-27	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Low----------	0.37	5	6
	9-60	18-28	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Moderate-----	0.37		
Lawson----------	0-19	10-27	1.20-1.55	0.6-2.0	0.22-0.24	6.1-7.8	Low----------	0.28	5	5
	19-30	10-30	1.20-1.55	0.6-2.0	0.18-0.22	6.1-7.8	Low----------	0.28		
	30-60	18-30	1.55-1.65	0.6-2.0	0.18-0.20	6.1-7.8	Moderate-----	0.43		
5030*. Pits										
5040*. Orthents										

* 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 "occasional," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
13B*:										
Olmitz	B	None	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
Zook	C/D	Occasional	Brief to long.	Feb-Nov	0-3.0	Apparent	Nov-Jul	High	High	Moderate.
Colo	B/D	Occasional	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	High	High	Moderate.
23C, 23C2 Arispe	C	None	---	---	2.0-4.0	Perched	Nov-Jul	High	High	Moderate.
24D, 24D2, 24E, 24E2, 24E3, 24F, 24F2 Shelby	B	None	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
51, 51B Vesser	C	Occasional	Brief	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	High	High	Moderate.
54, 54+ Zook	C/D	Occasional	Brief to long.	Feb-Nov	0-3.0	Apparent	Nov-Jul	High	High	Moderate.
56C Cantril	B	None	---	---	2.0-4.0	Apparent	Nov-Jul	High	Moderate	Low.
65D, 65E, 65F, 65F2, 65G Lindley	C	None	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
69C, 69C2 Clearfield	C	None	---	---	1.0-3.0	Perched	Nov-Jul	High	High	Low.
76C2 Ladoga	B	None	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
87B*:										
Zook	C/D	Occasional	Brief to long.	Feb-Nov	0-3.0	Apparent	Nov-Jul	High	High	Moderate.
Colo	B/D	Occasional	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	High	High	Moderate.
93D*, 93D2*, 93D3*:										
Shelby	B	None	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
Adair	C	None	---	---	1.0-3.0	Perched	Nov-Jul	High	High	Moderate.
94D*, 94D2*, 94E2*:										
Caleb	B	None	---	---	3.0-5.0	Perched	Nov-Jul	Moderate	Moderate	Moderate.
Mystic	C	None	---	---	3.0-5.0	Perched	Nov-Jul	High	Moderate	Moderate.

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			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
131B, 131C, 131C2-- Pershing	C	None--------	---	---	2.0-4.0	Perched	Nov-Jul	High-----	High-----	Moderate.
132C-------------- Weller	C	None--------	---	---	2.0-4.0	Perched	Nov-Jul	High-----	High-----	High.
133, 133B--------- Colo	B/D	Occasional	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
179D, 179D2, 179E, 179E2, 179E3, 179F, 179F2------ Gara	C	None--------	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
192C, 192C2, 192D, 192D2, 192D3----- Adair	C	None--------	---	---	1.0-3.0	Perched	Nov-Jul	High-----	High-----	Moderate.
211--------------- Edina	D	None--------	---	---	0.5-2.0	Perched	Nov-Jul	Moderate	High-----	Moderate.
220--------------- Nodaway	B	Occasional	Very brief to brief.	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	High-----	Moderate	Low.
222C, 222C2, 222C3, 222D2----- Clarinda	D	None--------	---	---	1.0-3.0	Perched	Nov-Jul	High-----	High-----	Moderate.
269--------------- Humeston	C/D	Occasional	Very brief	Feb-Nov	0-1.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
273B, 273C-------- Olmitz	B	None--------	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
362--------------- Haig	C/D	None--------	---	---	1.0-2.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
364B-------------- Grundy	C	None--------	---	---	1.0-3.0	Perched	Nov-Jul	High-----	High-----	Moderate.
368, 368B--------- Macksburg	B	None--------	---	---	2.0-4.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
369--------------- Winterset	C	None--------	---	---	1.0-2.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
370B, 370C, 370C2- Sharpsburg	B	None--------	---	---	>6.0	---	---	High-----	Moderate	Moderate.
423C2, 423D, 423D2------------ Bucknell	D	None--------	---	---	1.0-3.0	Perched	Nov-Jul	Moderate	High-----	Moderate.
425D, 425D2------- Keswick	C	None--------	---	---	1.0-3.0	Perched	Nov-Jul	High-----	High-----	Moderate.
430--------------- Ackmore	B	Occasional	Very brief to brief.	Sep-Jun	1.0-3.0	Apparent	Nov-Jul	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			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
452C2------------- Lineville	C	None---------	---	---	1.0-3.0	Perched	Nov-Jul	High-----	High-----	Moderate.
484--------------- Lawson	C	Occasional	Brief to long.	Mar-Nov	1.0-3.0	Apparent	Nov-May	High-----	Moderate	Low.
570C, 570C2------- Nira	B	None---------	---	---	4.0-6.0	Apparent	Nov-Jul	High-----	Moderate	Moderate.
592C2, 592D2------ Mystic	C	None---------	---	---	3.0-5.0	Perched	Nov-Jul	High-----	Moderate	Moderate.
730C*:										
Cantril-----------	B	None---------	---	---	2.0-4.0	Apparent	Nov-Jul	High-----	Moderate	Low.
Nodaway-----------	B	Occasional	Very brief to brief.	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	High-----	Moderate	Low.
792C, 792C2, 792D, 792D2, 792D3----- Armstrong	C	None---------	---	---	1.0-3.0	Perched	Nov-Jul	High-----	High-----	Moderate.
822C, 822C2, 822C3, 822D, 822D2, 822D3----- Lamoni	C	None---------	---	---	1.0-3.0	Perched	Nov-Jul	Moderate	High-----	Moderate.
892C2------------- Mystic Variant	D	None---------	---	---	1.0-3.0	Perched	Nov-May	High-----	High-----	Moderate.
993D2*, 993E2*:										
Gara--------------	C	None---------	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
Armstrong---------	C	None---------	---	---	1.0-3.0	Perched	Nov-Jul	High-----	High-----	Moderate.
1715*:										
Nodaway-----------	B	Frequent----	Very brief to brief.	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	High-----	Moderate	Low.
Lawson------------	C	Frequent----	Brief to long.	Mar-Nov	1.0-3.0	Apparent	Nov-Jul	High-----	Moderate	Low.
5030*. Pits										
5040*. Orthents										

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
Ackmore	Fine-silty, mixed, nonacid, mesic Aeric Fluvaquents
Adair	Fine, montmorillonitic, mesic Aquic Argiudolls
Arispe	Fine, montmorillonitic, mesic Aquic Argiudolls
Armstrong	Fine, montmorillonitic, mesic Aquollic Hapludalfs
Bucknell	Fine, montmorillonitic, mesic, sloping Udollic Ochraqualfs
Caleb	Fine-loamy, mixed, mesic Mollic Hapludalfs
Cantril	Fine-loamy, mixed, mesic Udollic Ochraqualfs
Clarinda	Fine, montmorillonitic, mesic, sloping Typic Argiaquolls
Clearfield	Fine, montmorillonitic, mesic, sloping Typic Haplaquolls
Colo	Fine-silty, mixed, mesic Cumulic Haplaquolls
Edina	Fine, montmorillonitic, mesic Typic Argialbolls
*Gara	Fine-loamy, mixed, mesic Mollic Hapludalfs
Grundy	Fine, montmorillonitic, mesic Aquic Argiudolls
Haig	Fine, montmorillonitic, mesic Typic Argiaquolls
Humeston	Fine, montmorillonitic, mesic Argiaquic Argialbolls
Keswick	Fine, montmorillonitic, mesic Aquic Hapludalfs
Ladoga	Fine, montmorillonitic, mesic Mollic Hapludalfs
Lamoni	Fine, montmorillonitic, mesic Aquic Argiudolls
Lawson	Fine-silty, mixed, mesic Cumulic Hapludolls
*Lindley	Fine-loamy, mixed, mesic Typic Hapludalfs
Lineville	Fine-loamy, mixed, mesic Aquollic Hapludalfs
Macksburg	Fine, montmorillonitic, mesic Aquic Argiudolls
Mystic	Fine, montmorillonitic, mesic Aquollic Hapludalfs
Mystic Variant	Fine, montmorillonitic, mesic, sloping Mollic Ochraqualfs
Nira	Fine-silty, mixed, mesic Typic Hapludolls
Nodaway	Fine-silty, mixed, nonacid, mesic Mollic Udifluvents
Olmitz	Fine-loamy, mixed, mesic Cumulic Hapludolls
Orthents	Loamy, mesic Udorthents
Pershing	Fine, montmorillonitic, mesic Aquollic Hapludalfs
Sharpsburg	Fine, montmorillonitic, mesic Typic Argiudolls
*Shelby	Fine-loamy, mixed, mesic Typic Argiudolls
Vesser	Fine-silty, mixed, mesic Argiaquic Argialbolls
Weller	Fine, montmorillonitic, mesic Aquic Hapludalfs
Winterset	Fine, montmorillonitic, mesic Typic Argiaquolls
Zook	Fine, montmorillonitic, mesic Cumulic Haplaquolls

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