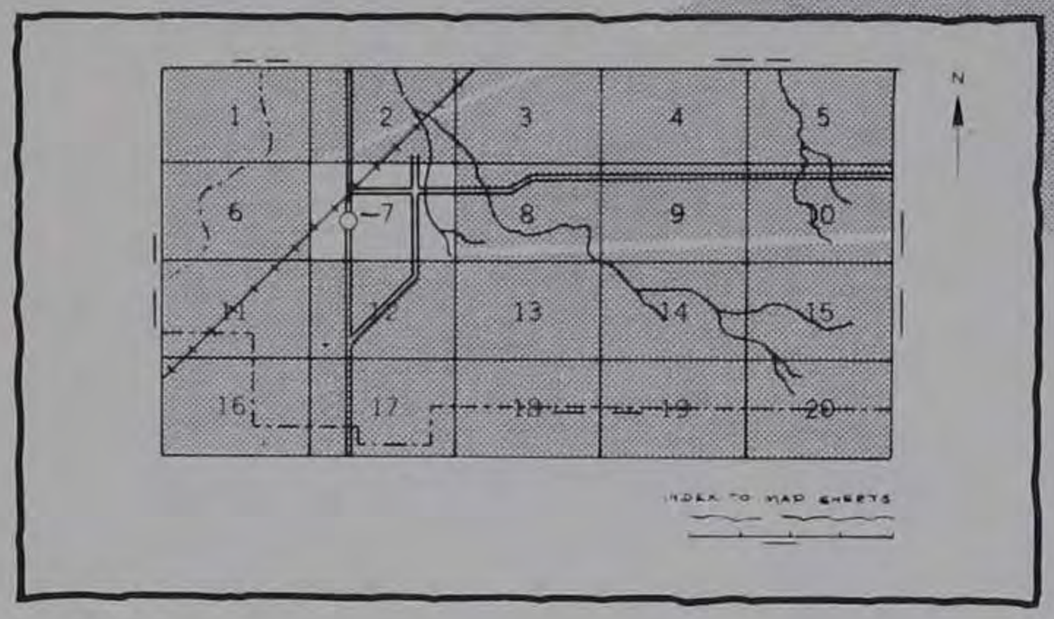
SOIL SURVEY OF

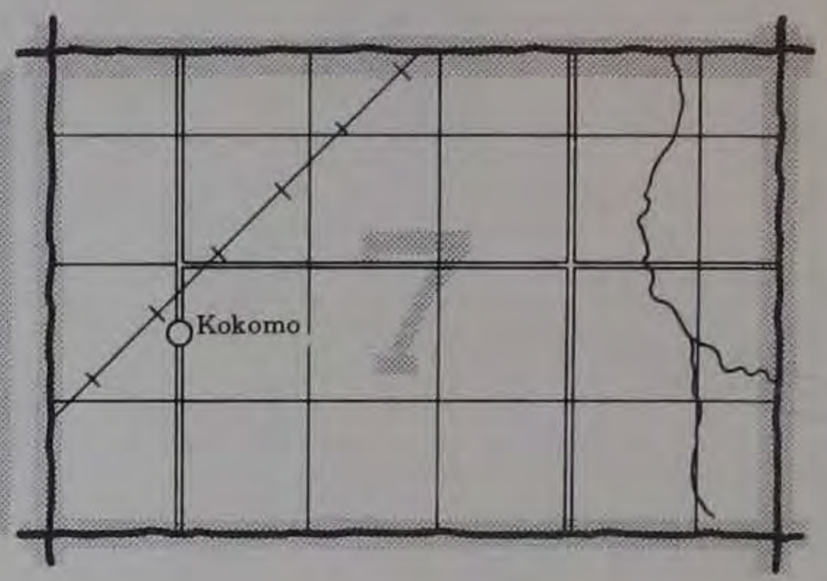
Poweshiek County, Iowa

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

HOW TO USE

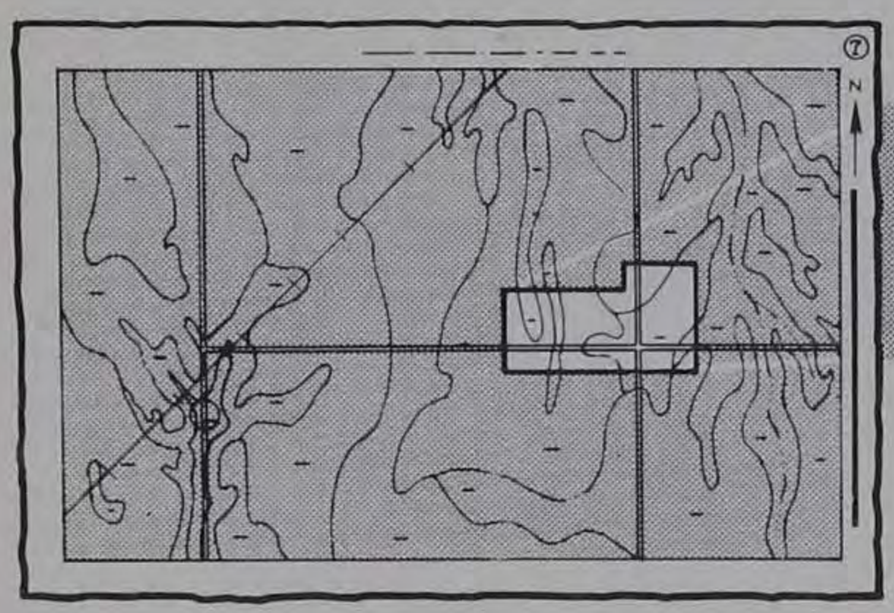
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

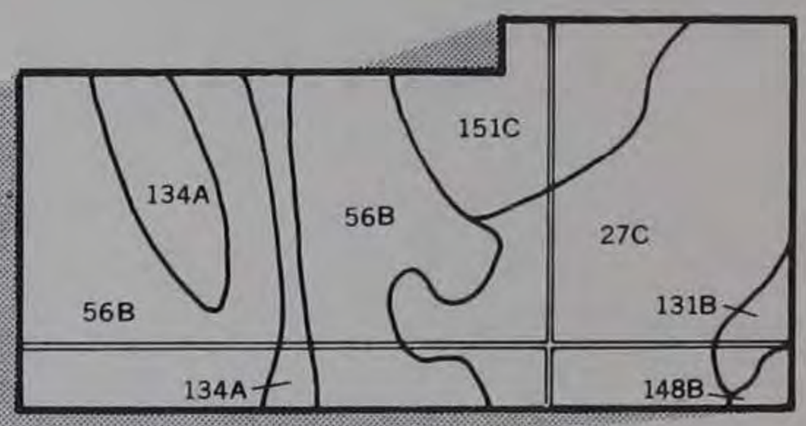




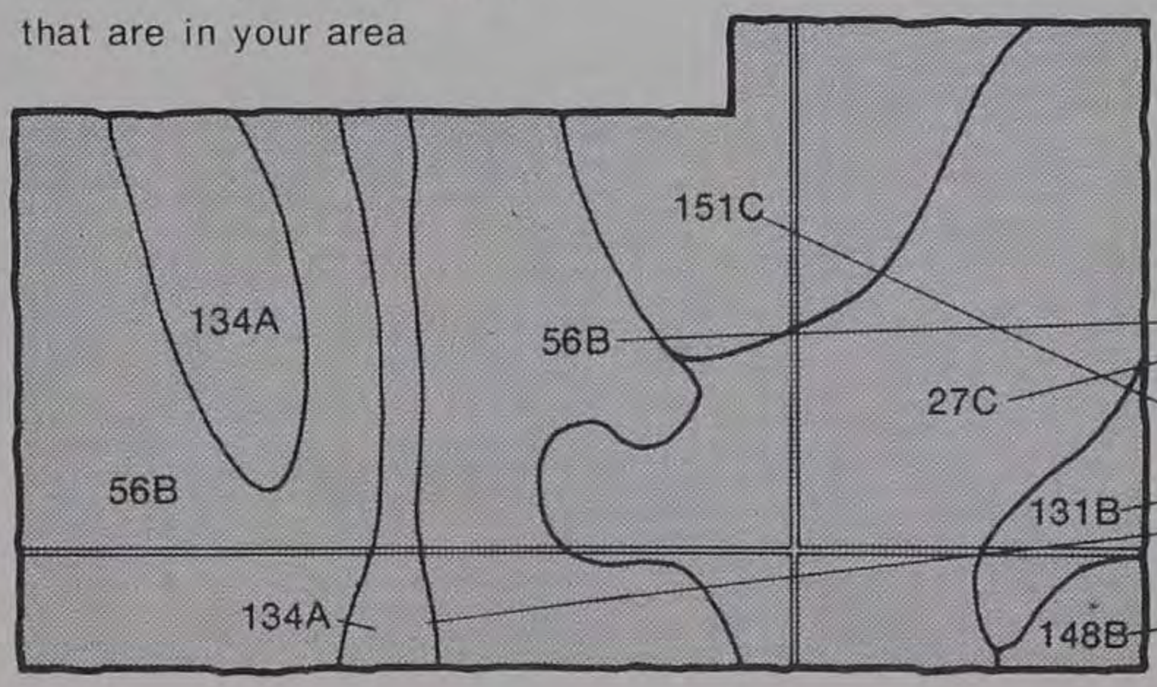
2. Note the number of the map sheet and turn to that sheet.

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





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

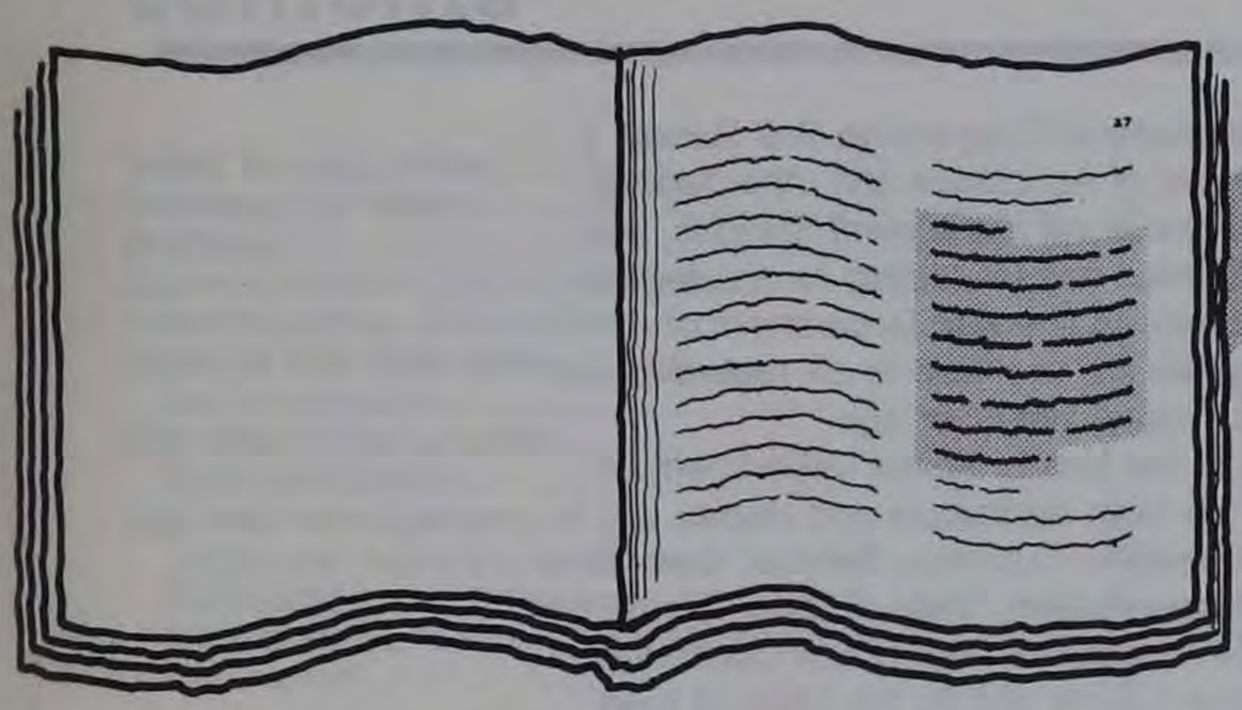


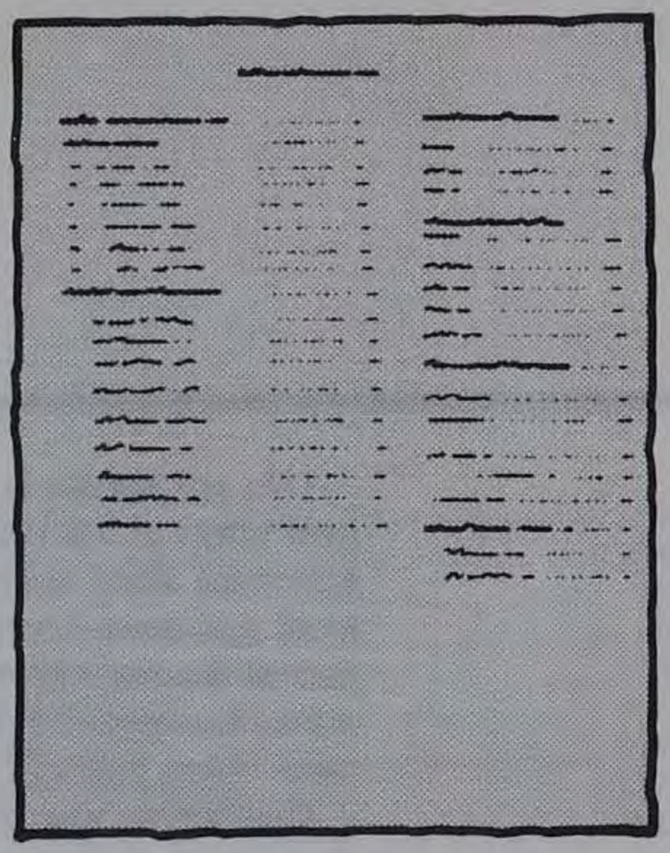
Symbols

27C
56B
131B
134A
148B
151C

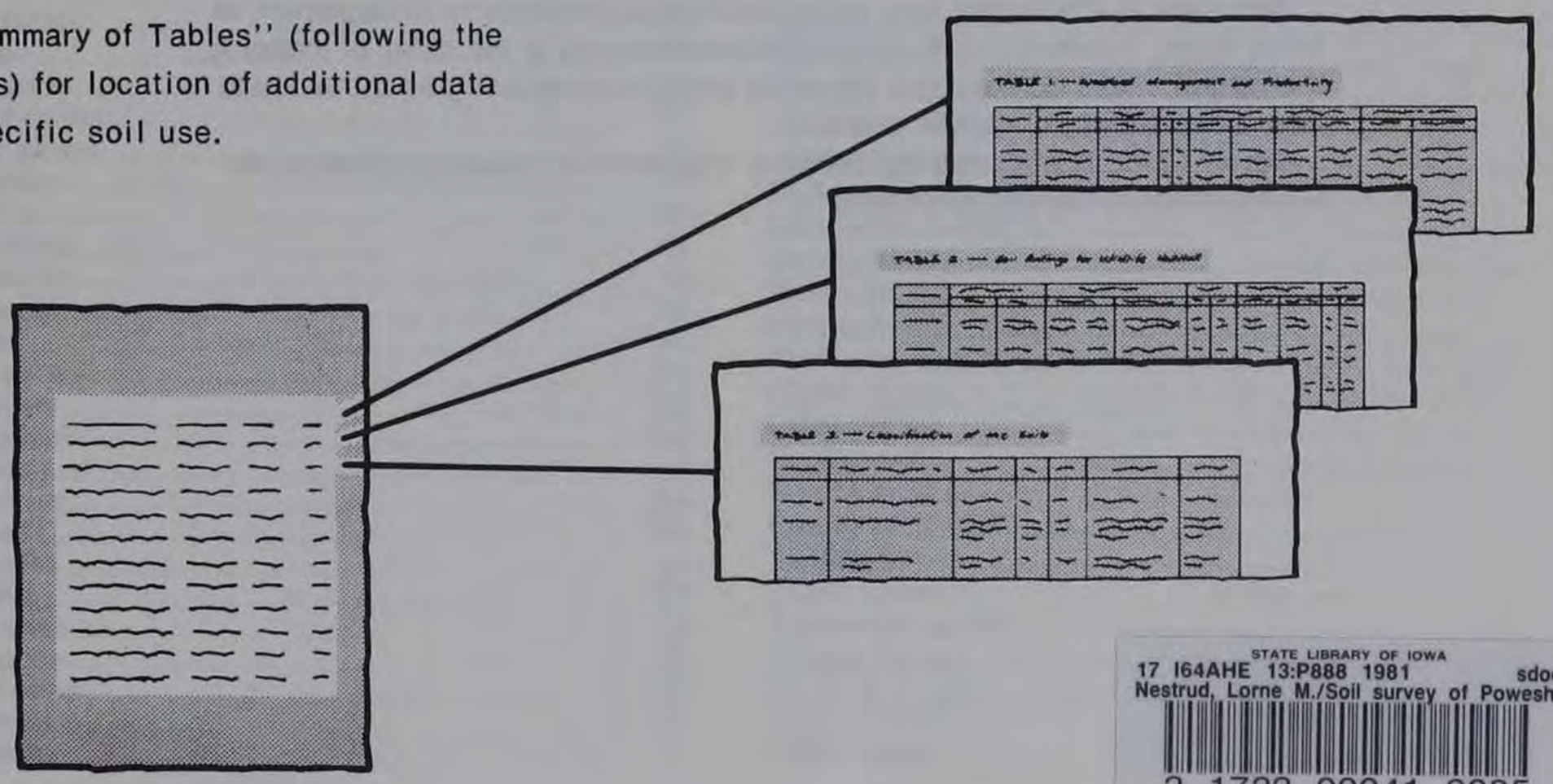
THIS SOIL SURVEY

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





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



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

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

This survey was made cooperatively by the United States Department of Agriculture, Soil Conservation Service; the Iowa Agriculture and Home Economics Experiment Station; the Cooperative Extension Service, Iowa State University; and the Department of Soil Conservation, State of Iowa. It is part of the technical assistance furnished to the Poweshiek County Soil Conservation District. Funds appropriated by Poweshiek County and by the State of Iowa were used to defray part of the cost of the survey. Major fieldwork was performed in the period 1974-1977. Soil names and descriptions were approved in 1978. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1977.

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: Contour stripcropping and crop rotation help reduce soil loss in the Gara-Lindley-Armstrong association.

contents

soil series

Issued November 1981

index to map units

summary of tables

preface

This soil survey contains information that can be used in land-planning programs in Poweshiek County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations inherent in the soil or hazards that adversely affect the soil, improvements needed to overcome the limitations or reduce the hazards, 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 insure 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
Poweshiek County, Iowa

By Lorne M. Nestrud, Soil Conservation Service

Fieldwork by Lorne M. Nestrud, Elmer H. Harvey, Douglas B. Oelmann, Gary A. Lindgren, James Hart, and Robert C. Russell
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 Department of Soil Conservation, State of Iowa

Poweshiek County is in south-central Iowa (fig. 1). The western boundary is about 45 miles east of Des Moines, Iowa. The county contains 16 full townships. It is 583 square miles, or 376,960 acres.

The county is chiefly rural. The principal crops are corn, soybeans, oats, and alfalfa hay. Pasture and some timbered areas make up about 45 percent of the farmland. Livestock, mainly beef cattle and hogs, are raised on many farms.

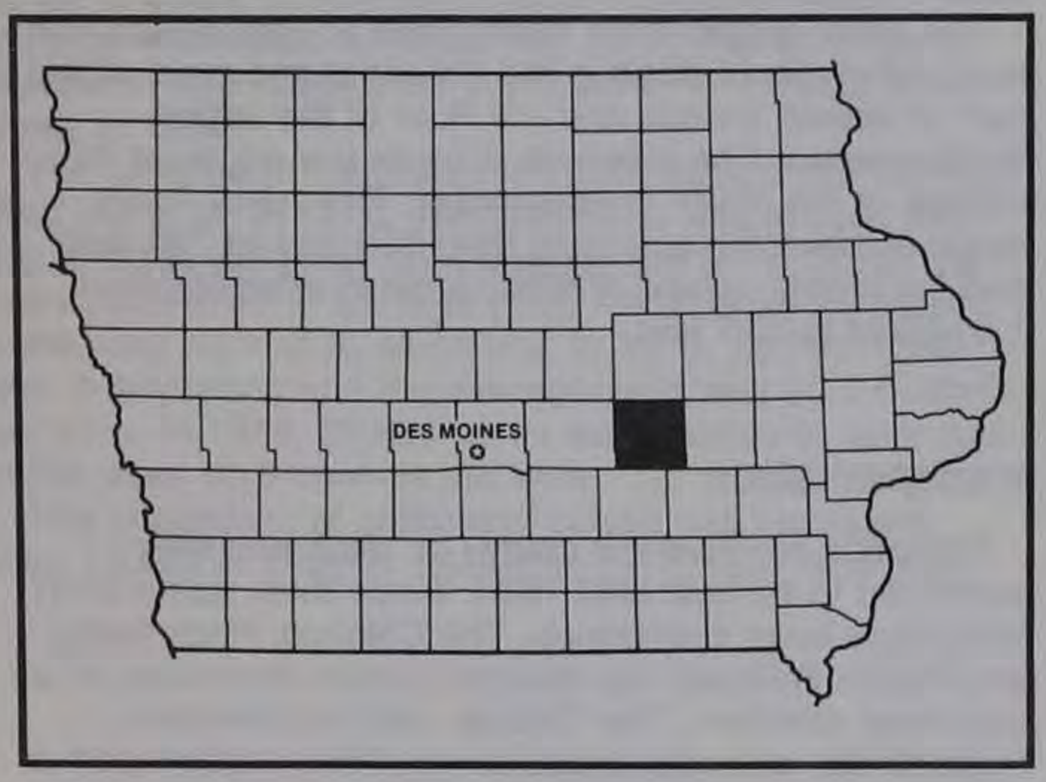


Figure 1.—Location of Poweshiek County in Iowa.

The population of Poweshiek County was 18,803 in 1970. The largest city in the county is Grinnell, which had a population of 8,402. In 1970 the farm population was 6,309.

A previous soil survey was completed in March 1935 (*4*). It was made by the Iowa Agricultural Experiment Station at Ames, Iowa. It had also been published in 1929 in cooperation with the U.S. Department of Agriculture (*3*). This survey of Poweshiek County updates the earlier surveys and provides additional information and larger maps that show the soils in greater detail.

general nature of the survey area

This section tells about the history, farming, transportation, topography and drainage, and climate of Poweshiek County.

history

Poweshiek County was established in 1848 and was named after Poweshiek, a chief of the Fox Indians (*7*). On this date there were about 300 inhabitants in this vicinity. The first courthouse was built in 1850, and the present courthouse was built in 1857. The first settlements were established in 1843 at Carnforth and Forest Grove. In the first 10 years, the county increased

in population to about 1,600; by 1860 the population was nearing 5,700.

The town of Grinnell was established about 1854 and was incorporated by 1865. By 1900 there were 3,860 inhabitants, by 1960 there were 7,367, and by 1970 there were 8,402 inhabitants. Grinnell was the only town that showed an increase in population from 1960 to 1970. The other towns showed a decrease in population. The total urban population, however, increased 14 percent, and the rural population decreased 12.8 percent. The total change in population in the county decreased 2.6 percent.

climate

Poweshiek County is cold in winter and is quite hot with occasional cool spells in summer. During the winter precipitation frequently occurs as snowstorms, and during the warm months it is chiefly rain, 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 Grinnell, Iowa, for the period 1951 to 1973. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on the length of the growing season.

In winter the average temperature is 22 degrees F, and the average daily minimum temperature is 13 degrees. The lowest temperature on record, -29 degrees, was recorded at Grinnell on January 22, 1970. In summer the average temperature is 72 degrees, and the average daily maximum is 83 degrees. The highest temperature, 104 degrees, was recorded on July 30, 1955.

Growing degree days, shown in table 1, are equivalent to "heat units." Beginning in spring, 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.

Of the total annual precipitation, 25 inches, or 71 percent, usually falls during the period from April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall from April through September is less than 20 inches. The heaviest 1-day rainfall during the period of record was 6.92 inches at Grinnell on August 5, 1970. Thunderstorms number about 50 each year, 25 of which are in summer.

Average seasonal snowfall is 32 inches. The greatest depth of snow at any one time during the period of record was 30 inches. On the average, 7 days have at least 1 inch of snow on the ground, but the number of days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night in all seasons, and the average at dawn is about 80 percent. The percentage of possible sunshine is 70 percent in summer and 50 percent in winter. The prevailing direction of the wind is from the northwest. Average windspeed is highest, 13 miles per hour, in April.

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

relief and drainage

The natural drainage of Poweshiek County is provided by North Skunk River and its immediate tributaries, which cut through the southwest corner of the county. The North Skunk River and its tributaries drain the southwestern third of the county. The creeks and rivers that branch off the Iowa River drain the remaining two thirds of the county. The main tributaries of the Iowa River are: the Walnut Creek, which is in the northern part of the county and drains east into the Iowa River, and the Bear Creek and its tributaries, which drain the north-central part of the county and flow east out of the county. The North Fork English River and its tributaries drain the southeastern part of the county.

The highest part of the county is in the northwest. The main ridge extends from the west-central edge of the county and extends southeast past the town of Montezuma. There are some poorly drained soils on flats and in depressions on this high ridge. These ridges can be seen on the General Soil Map.

Poweshiek County is part of an extensive plain of glacial drift that is mantled with loess. The drainage valleys are generally 150 to 200 feet lower than the top of the divides between the North Skunk River, Walnut Creek, Bear Creek, North Fork English River, and their major tributaries.

The relief ranges from nearly level to very steep. The most nearly level slope is the broadest and most stable part of upland divides and the floor of the larger drainageways. The steepest slope is the edges of the valleys of the major drainageways. The valley floors range in elevation generally from 850 feet to 790 feet, and the stable upland divides range in elevation from 1,010 feet to 970 feet.

transportation

Railroads reached the county in 1862, and they continued to be built until 1884. Since then, some short lines have been abandoned. The Chicago, Rock Island and Pacific Railroad line extends across the county in an east-west direction. The Chicago and Northwestern Railroad line extends across most of the western part of the county in a north-south direction providing service to the towns of Grinnell and Searsboro.

A network of Federal, state, and county highways serves all parts of the county. Interstate Highway 80 provides east-west service through the central part of the county. U.S. Highway 6 enters the county at Grinnell and leaves in the eastern part of the county, north of the town of Victor. U.S. Highway 63 serves the towns of Montezuma and Malcom and extends mainly in a north-south direction through the county. Hard surface roads connect all cities and towns in the county. Nearly all farms have access to all-weather, farm-to-market roads. These roads are mainly made of crushed stone.

Most communities have freight service by truck. Bus service is on U.S. Highway 6 or on Interstate Highway 80 and serves the communities along the route.

A few private and small community airfields are located in the vicinity of the towns of Grinnell, Brooklyn, and Montezuma.

farming

In this section the statistics used are from the 1974 Census of Agriculture and the 1976 and 1977 Iowa Agricultural Statistics Reports (*16*).

Since 1969 the number of people living on farms has decreased and the total acreage in farms has decreased about 8,000 acres. In the last few years the average acreage of farms has generally decreased, but it stayed nearly the same during 1976 and 1977. The average size of a farm was 246 acres in 1969, and it was 269 acres in 1977. From 1969 to 1977 the number of farms decreased from 1,457 to 1,350. In 1969, 24.7 percent of the farms were managed by tenant operators, and in 1974 this percentage decreased to 18.4. The state average for farms managed by tenants was 24 percent in 1969 and 20 percent in 1974.

The acreage in crops has increased. In 1969, 198,236 acres was in crops. In 1974 this increased to 243,309 acres. In 1969, 59,899 acres was in pasture. This acreage decreased to 56,921 by 1974. The acreage in woodland decreased from 9,318 acres in 1969 to 8,660 acres in 1974.

The acreage in corn has increased as has the average yield per acre. In 1976, 126,300 acres was in corn and the average yield was 96.4 bushels per acre. Soybeans have decreased in acreage since 1974. In 1974, 68,280 acres was planted to soybeans. In 1976, 55,300 acres was in soybeans and the average yield was 35.1 bushels per acre. In 1976, 23,600 acres was planted to oats and yields were 60.5 bushels per acre.

The population of cattle and calves has increased from 75,323 in 1969 to 94,000 in 1977; hogs and pigs increased from 165,630 in 1969 to 224,100 in 1976. Sheep and lambs decreased from 8,705 in 1969 to 4,631 in 1974.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, woodland managers, engineers, planners, developers and builders, home buyers, and others.

general soil map units

The general soil map at the back of this publication shows broad areas called soil associations that have a distinctive pattern of soils, relief, and drainage. Each soil association on the general soil map is a unique natural landscape. Typically, a soil 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 other associations 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 soil association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

soil descriptions

The general soil map of Poweshiek County shows eight soil associations. Seven of them are on uplands and one is on bottom land. These soil associations are described in the following paragraphs.

1. Tama-Killduff association

Gently and moderately sloping, well drained and moderately well drained soils that formed in loess; on uplands

This association consists mainly of gently sloping and moderately sloping soils on ridgetops and side slopes (fig. 2). It makes up 34 percent of the county. It is about 45 percent Tama soils, 23 percent Killduff soils, and the remaining 32 percent is minor soils.

Tama soils, in this association, are on convex ridgetops and side slopes. These soils are well drained.

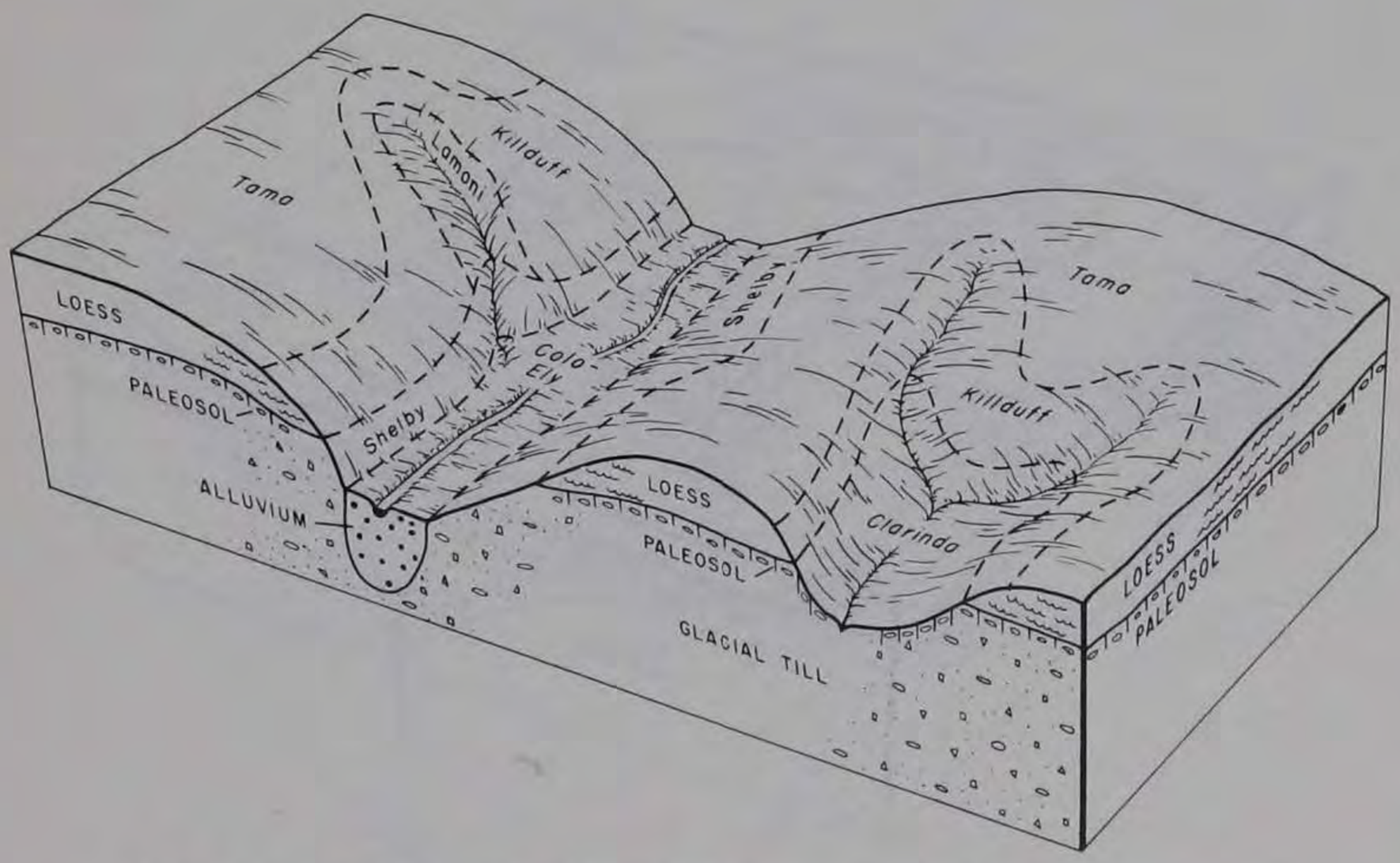


Figure 2.—Relationship of slope and parent materials to soils of the Tama-Killduff association.

They formed in loess and under grasses. The surface layer is black silty clay loam. The subsurface layer is very dark brown and black silty clay loam, and the subsoil is dark brown and brown silty clay loam.

Killduff soils are moderately sloping and are on convex side slopes. They are near the heads of drainageways. They are moderately well drained. They formed in loess and under grasses. The surface layer is black silty clay loam. The subsoil is brown silty clay loam in the upper part grading to mottled yellowish brown and grayish brown silt loam in the lower part.

The minor soils in this association are the poorly drained Colo and Clarinda soils, the somewhat poorly drained Ely and Lamoni soils, and the moderately well drained Shelby soils. The Colo and Ely soils are in drainageways, and the Clarinda, Lamoni, and Shelby soils are downslope from the major soils.

These soils have high available water capacity. Drainage generally is adequate for most crops, but in many places water seeps in a narrow band where the loess comes in contact with the weathered glacial till. These seeps are on side slopes. They are most prevalent in the spring. Subsurface drains are beneficial in these seep areas.

Farming is diversified, but grain and livestock are the main farm products. Much of the acreage is used for row crops, especially corn and beans. Most of these soils can be terraced, stripcropped, and tilled on the contour, since most of them have long and uniform slopes.

The trend is toward combining small farms into larger ones.

2. Muscatine-Garwin association

Nearly level, somewhat poorly drained and poorly drained soils that formed in loess; on uplands

This association consists mainly of soils on wide ridgetops or divides (fig. 3). These divides have the highest elevation in the county. This association makes up 5 percent of the county. It is about 70 percent Muscatine soils, 25 percent Garwin soils, and 5 percent minor soils.

The nearly level Muscatine soils are in slightly convex areas that border the more level Garwin soils. Muscatine soils are somewhat poorly drained. They formed in loess and under a native vegetation of grass. The surface layer and the subsurface layer are black silty clay loam. The subsoil is dark grayish brown silty clay loam that has grayish brown mottles in the lower part.

Garwin soils are level and slightly concave. They are in the divides at the heads of drainageways. They are poorly drained and formed under prairie grasses. The surface layer is black silty clay loam. The subsurface layer is black and very dark gray silty clay loam. The subsoil is silty clay loam that is very dark gray in the upper part and grades downward to dark gray and gray.

Minor in this association are the poorly drained or very poorly drained Sperry soils. These nearly level soils are in slight depressions on broad upland divides and are bordered by the Muscatine and Garwin soils.

These soils have high available water capacity. In many places natural drainage is slow. The proper

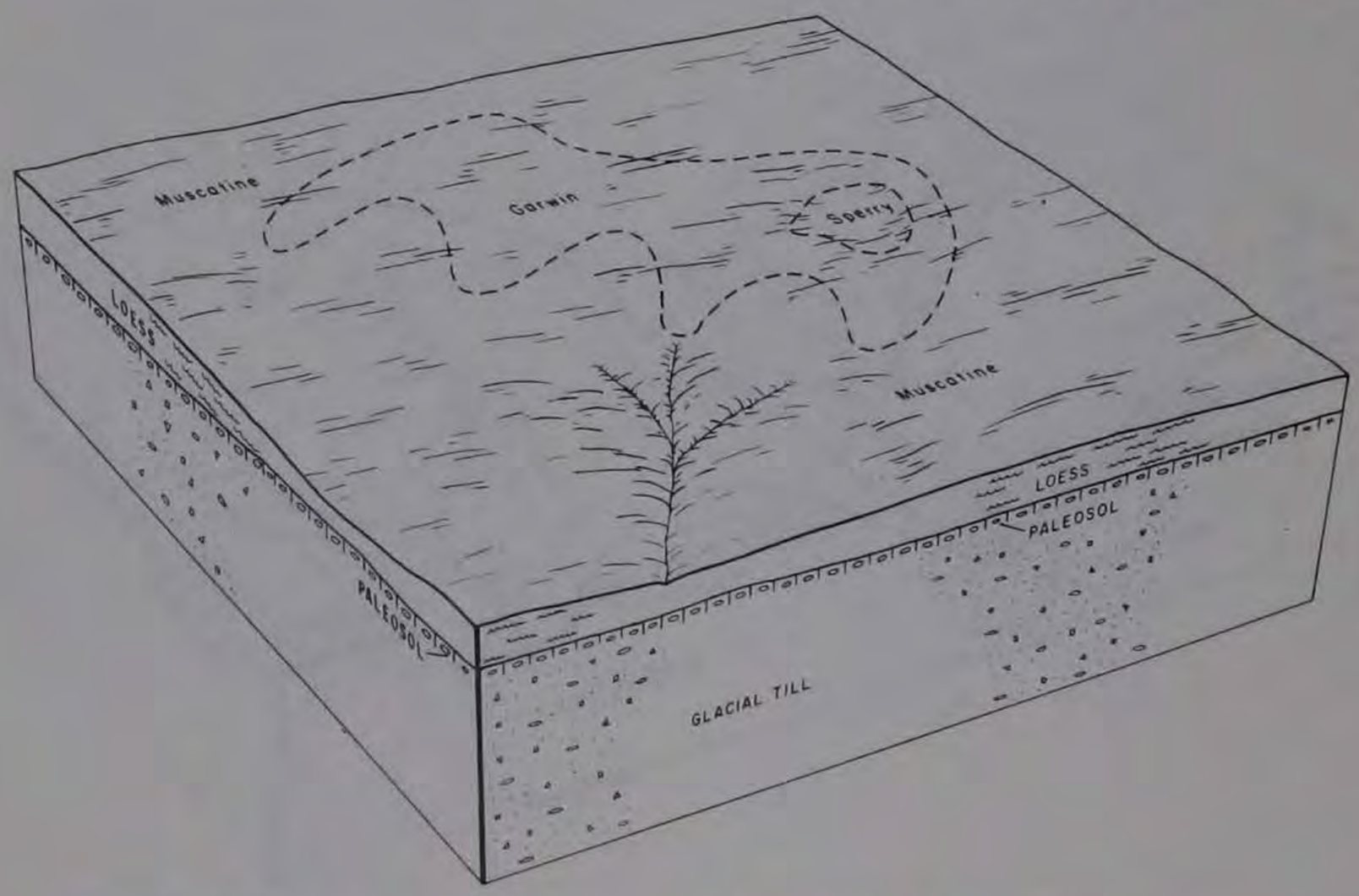


Figure 3.—Relationship of slope and parent materials to soils of the Muscatine-Garwin association.

placement of subsurface or open drains allows for timely field operations.

The soils in this association are suited to crops. Corn and soybeans are the major crops. The only permanent pasture is in small lots near farmsteads. Very few farms are located entirely within this soil association.

3. Downs-Tama-Shelby association

Moderately to strongly sloping, well drained soils that formed in loess and glacial till; on uplands

This association consists mainly of moderately to strongly sloping soils on side slopes that have many drainageways.

This association makes up about 8 percent of the county. It is about 30 percent Downs soils, 24 percent Tama soils, 16 percent Shelby soils, and 30 percent numerous minor soils (fig. 4).

Downs soils are mainly on the sides of ridges downslope from the Tama soils. These Downs soils formed in loess and under a cover of grasses and trees. Downs soils have a surface layer of very dark gray silt loam, a subsurface layer of dark grayish brown silt loam, and a subsoil of brown and yellowish brown silty clay loam.

Tama soils are on the upper part of the side slope. They formed under a native vegetation of grasses. They are well drained. They have a surface layer of black silty clay loam. The subsurface layer is very dark brown and black silty clay loam, and the subsoil is dark brown and brown silty clay loam.

Shelby soils are downslope from the Downs and Tama soils. They formed in glacial till and under a vegetation of grasses. They have a surface layer of very dark grayish brown loam. The subsoil is dark brown, yellowish brown, and brown clay loam. The substratum is dark yellowish brown and yellowish brown clay loam.

The minor soils in this association are mainly the Adair, Armstrong, Colo, Ely, and Gara soils. Adair, Armstrong, and Gara soils are downslope from the Downs and Tama soils. They formed in glacial till. Adair soils formed under grasses. Armstrong and Gara soils formed under a vegetation of grasses and trees. The Colo and Ely soils are in drainageways and on foot slopes. They formed in local alluvium and colluvium.

These soils have high available water capacity. Drainage generally is adequate for most crops grown in the county. In many places water seeps in a narrow band on the side slopes where the loess comes in contact with the glacial till. These seeps are most prevalent in the spring. Subsurface drains intercept water in the seep area.

Farming is diversified in this association, but grain and livestock are the main farm products. Much of the acreage is used for row crops, especially corn and beans. Most of these soils can be terraced, stripcropped, and tilled on the contour, since most of them have long and uniform slopes.

The trend is toward combining small farms into larger ones.

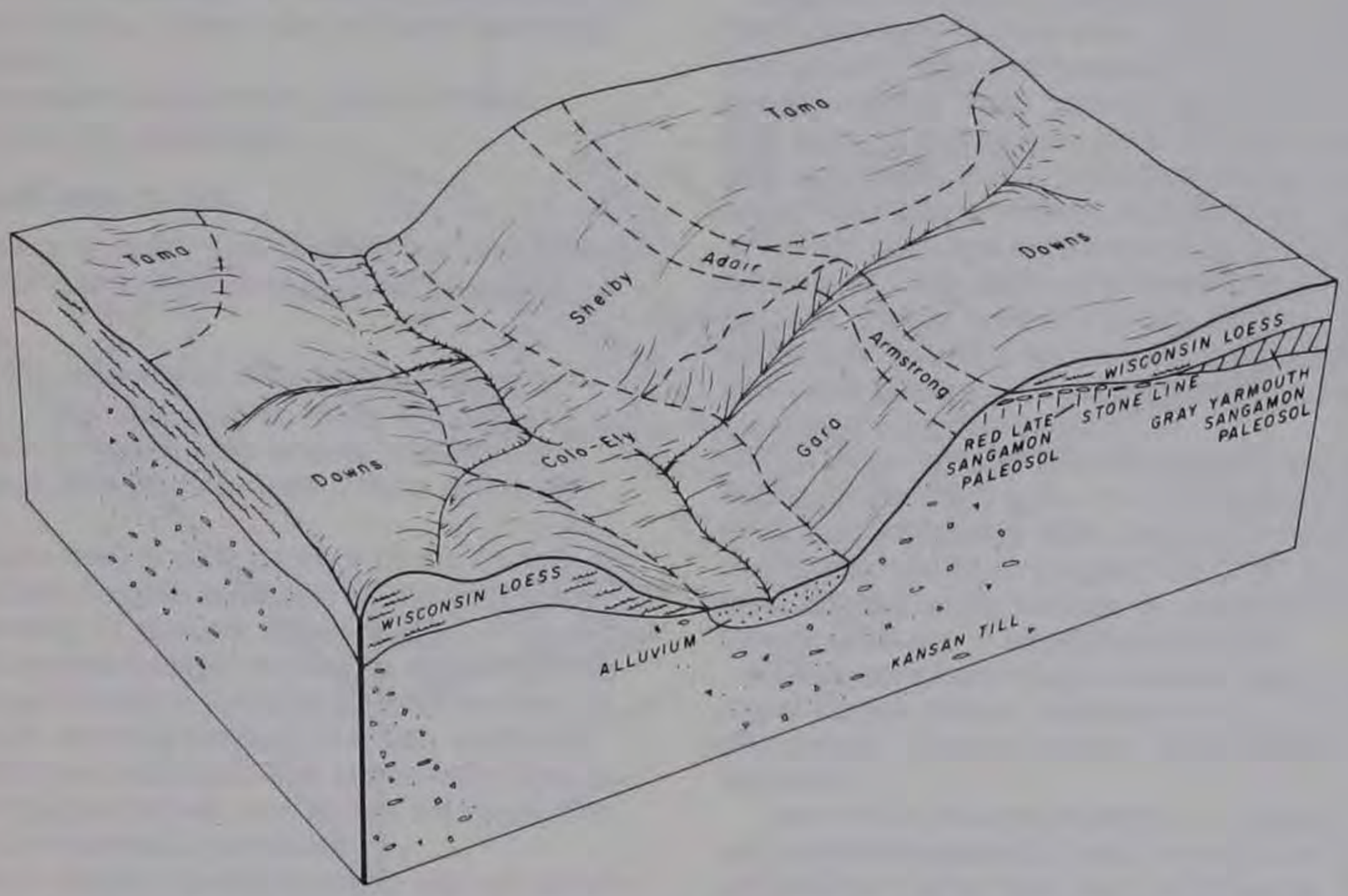


Figure 4.—Relationship of slope and parent materials to soils of the Downs-Tama-Shelby association.

4. Colo-Nodaway association

Nearly level, poorly drained and moderately well drained soils that formed in alluvium; on bottom lands

This association consists of nearly level soils on bottom lands. Nearly all the soils formed in alluvium; however, some of the benches are covered by a thin layer of loess.

This association makes up 8 percent of the county. It is about 38 percent Colo soils, 25 percent Nodaway soils, and 37 percent numerous minor soils.

The Colo soils are on smooth bottom lands, on alluvial fans, and at the base of upland slopes. They usually are between the Nodaway soil, which is next to the stream channel, and the Zook soil, which is generally some distance from the stream channel. Colo soils formed in silty alluvium. These soils are poorly drained. Typically, the surface and subsurface layers are black silty clay loam to a depth of 36 inches. The substratum is very dark gray and dark gray silty clay loam.

Nodaway soils are generally adjacent to the present stream channel and alluvial fans, but they can be at some distance from the channel if it has been straightened. Nodaway soils formed in stratified silty alluvium. These soils are moderately well drained. They are stratified very dark grayish brown, dark grayish brown, and grayish brown silt loam to a depth of 38 inches. The underlying alluvium is usually black silty clay loam.

Some of the minor soils are the Ackmore, Lawson, Nevin, and Zook soils. Ackmore soils are similar to the Nodaway soil but are not as deep to the underlying black silty clay loam. Zook soils are poorly drained and contain more clay than the Colo soil. Lawson soils are somewhat poorly drained and contain less clay than the Colo soil. Nevin soils are somewhat poorly drained and are on low benches or on second bottoms along streams.

Many of the soils in this association are used for pasture. Some are used for row crops and hay. Nearly all the soils in this association have a seasonal high water table and are subject to flooding. Control of flooding and installation of surface drains are beneficial in most areas.

5. Otley-Ladoga association

Gently and moderately sloping, moderately well drained soils that formed in loess; on uplands

This association consists of gently and moderately sloping soils on convex ridgetops and side slopes (fig. 5). It makes up 32 percent of the county. It is about 40 percent Otley soils and 10 percent Ladoga soils. The remaining 50 percent is minor soils.

Otley soils are on moderately broad, convex ridgetops and side slopes. They formed in loess and under grasses. The surface layer is black silty clay loam. The subsurface layer is black and very dark grayish brown

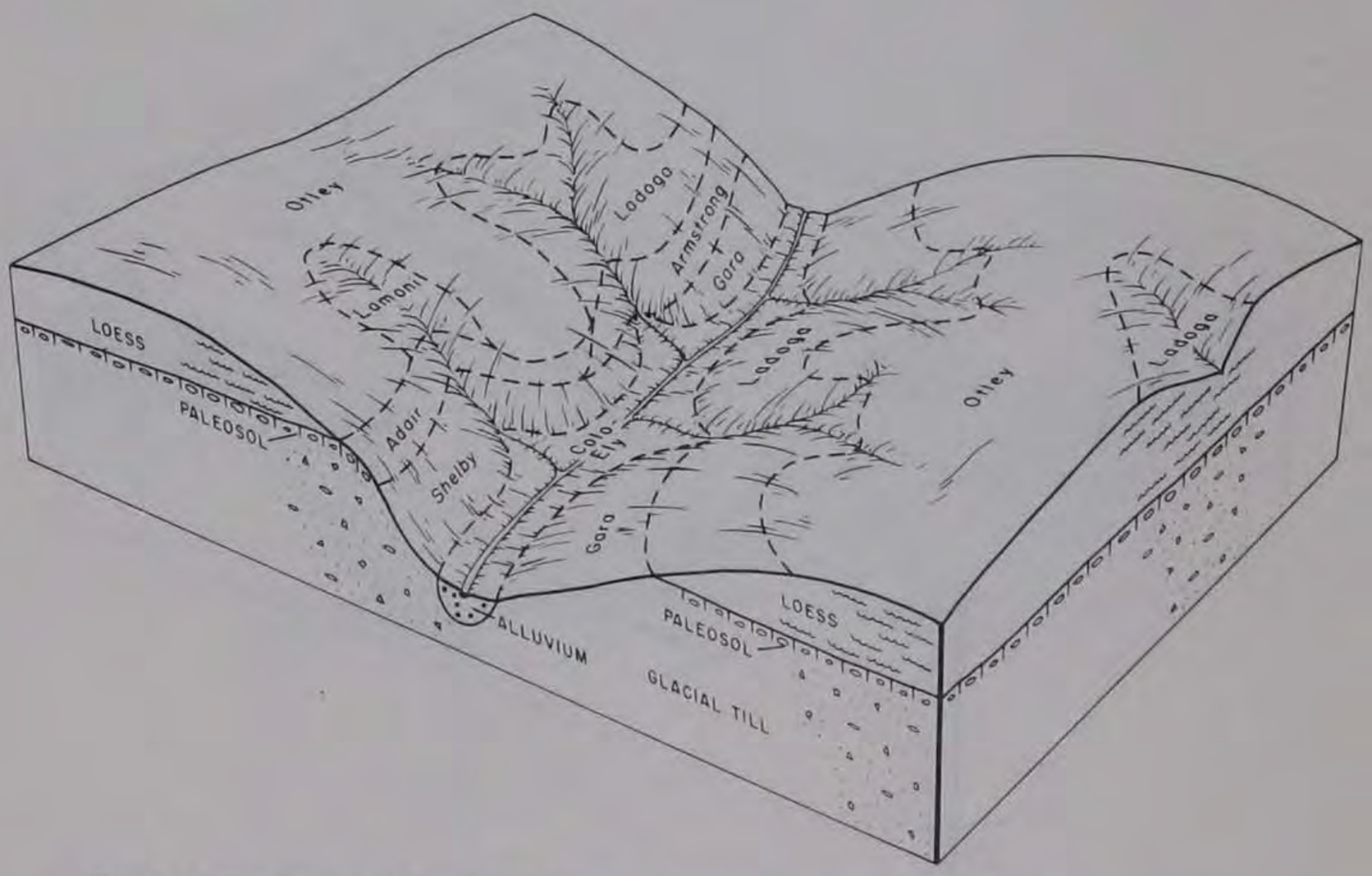


Figure 5.—Relationship of slope and parent material to soils of the Otley-Ladoga association.

silty clay loam. The subsoil is mainly brown silty clay loam.

Ladoga soils are on narrow, convex ridgetops and side slopes and are generally lower on the landscape than Otley soils. They formed in loess and under a cover of grasses and trees. The surface layer is black or very dark grayish brown silt loam, the subsurface layer is dark grayish brown and grayish brown silt loam. The subsoil is brown silty clay loam.

Among the minor soils in this association are the moderately well drained to somewhat poorly drained Adair and Armstrong soils, the somewhat poorly drained Lamoni soils, and the well drained to moderately well drained Gara soils. These soils formed in glacial till and are downslope from the major soils. The moderately well drained Hedrick soils are generally at the heads of drainageways and formed in loess. The Colo and Ely soils are in drainageways and on foot slopes. They formed in alluvium.

These soils have high available water capacity. Drainage generally is adequate for most crops grown. In many places water seeps in a narrow band on side slopes and at heads of drainageways, where the loess comes in contact with the weathered glacial till. These seeps are most prevalent during wet seasons, especially in the spring. Subsurface drains are beneficial in these seep areas. Scattered trees and shrubs are along some of the drainageways and fence rows.

Farming is diversified in this association, but grain and livestock are the main farm products. Much of the acreage is used for row crops, especially corn and beans. Most of these soils can be terraced, stripcropped, and tilled on the contour, since most of them have long and uniform slopes.

The trend is towards larger farms. Some farmers operate more than one small farm.

6. Fayette-Gara association

Moderately sloping to steep, well drained and moderately well drained soils that formed in loess and glacial till; on uplands

This association consists of moderately sloping and steep soils on convex side slopes. Many irregularly shaped areas are on steep side slopes, adjacent to drainageways and along fence rows. These areas are used for trees.

This association makes up 2 percent of the county. It is about 48 percent Fayette soils and 35 percent Gara soils. The remaining 17 percent is minor soils.

Fayette soils are moderately sloping to steep soils on side slopes. They formed in loess and under a cover of trees. These soils are well drained. The thin surface layer is very dark gray silt loam. The subsurface layer is dark gray, dark grayish brown, and brown silt loam. The subsoil is mainly brown silty clay loam.

Gara soils are strongly sloping to steep and on convex side slopes. They are at the lower elevations. These soils formed in glacial till and under a cover of grasses and trees. They are moderately well drained to well drained. The surface layer is very dark gray loam. The subsurface layer is dark grayish brown and brown loam. The subsoil is mainly yellowish brown clay loam.

The minor soils in this association are the moderately well drained Armstrong soils that are upslope from Gara soils, the well drained Lindley soils that are downslope from Fayette soils, and the moderately well drained or well drained Shelby soils. The Shelby soils formed under a cover of grasses.

These soils have high available water capacity. They are well drained or moderately well drained. In many places water seeps in a narrow band where the loess and the glacial till come in contact. The less sloping soils are moderately suited to row crops. Generally the steeper side slopes are in meadow or pasture. Some ponds are present for watering livestock. The principal management need is to control erosion. Where it is feasible, the cropland should be terraced and contoured. General improvement of fertility is also needed.

Generally the farms are larger in this area. In places the farms have been combined.

7. Mahaska-Taintor association

Nearly level, somewhat poorly drained and poorly drained soils that formed in loess; on uplands

This association consists of soils on wide ridgetops or divides. It makes up 5 percent of the county. It is about 43 percent Mahaska soils and 35 percent Taintor soils. The remaining 22 percent is minor soils.

Mahaska soils are in slightly convex areas that border the more level Taintor soils. These soils formed in loess and under a cover of grasses. The soils are somewhat poorly drained. They have a surface layer of black silty clay loam, a subsurface layer of black and very dark gray silty clay loam, and a subsoil of mainly dark grayish brown and grayish brown, mottled silty clay loam.

Taintor soils are on the most nearly level parts of the landscape. They formed in loess and under a cover of grasses. These soils are poorly drained. They have a surface layer and a subsurface layer of black silty clay loam and a subsoil of mainly mottled olive gray and light olive gray silty clay loam.

The minor soils in this association are the moderately well drained Otley soils, the somewhat poorly drained Givin and Atterberry soils, and the poorly drained or very poorly drained Sperry soils. The Givin and Atterberry soils formed under a cover of grasses and trees. The Sperry soils are in slight depressions.

These soils have high available water capacity. In many places natural drainage is slow. The proper placement of subsurface or open drains allows for timely fieldwork.

The soils in this association are suited to crops. Corn and soybeans are the major crops. The only permanent pasture is in small lots near farmsteads. Very few farms are located entirely within this soil association.

8. Gara-Lindley-Armstrong association

Strongly sloping to very steep, well drained to somewhat poorly drained soils that formed in glacial till; on uplands

This association consists of soils which are dissected by drainageways and which border the major streams. In many areas these soils have been cleared of trees and are used for pasture. Some soils remain in woodland but are also used for pasture. Characteristic features of the association are narrow, rounded ridgetops; long, steep, convex side slopes, and narrow valleys in uplands. The cultivated fields are on ridgetops and are irregular in shape.

This association makes up about 6 percent of the county. It is about 33 percent Gara soils, 24 percent Lindley soils, and 17 percent Armstrong soils. The other 26 percent is minor soils.

Gara soils are on the lower part of convex side slopes. They are strongly sloping to steep soils. They formed in glacial till and under a cover of grasses and trees. These soils are moderately well drained and well drained. The surface layer is very dark gray loam. The subsurface layer is dark grayish brown and brown loam. The subsoil is mainly yellowish brown clay loam.

Lindley soils are on the lower part of side slopes of divides that are dissected by drainageways. These soils are strongly sloping to very steep soils. They formed in glacial till and under a cover of trees. The soils are well drained and moderately well drained. The thin surface layer is very dark gray loam. The subsurface layer is dark grayish brown and brown loam. The subsoil is mainly yellowish brown clay loam.

Armstrong soils are upslope from the Gara and Lindley soils. The Armstrong soils are moderately well drained to somewhat poorly drained. They are strongly sloping soils. They formed in glacial till and under a cover of grasses and trees. The surface layer is very dark grayish brown and grayish brown loam. The subsoil is dark yellowish brown and brown clay loam and loam that has red mottles in the upper part.

The minor soils are the moderately well drained Clinton, Keswick, Hedrick, and Ladoga soils and the excessively drained Sparta soils. Clinton soils formed from loess and under a cover of trees. These soils are upslope from the major soils in the association. Keswick soils are on shoulders of side slopes. They are above Lindley soils and below Clinton soils. Hedrick soils are downslope from the summit and are on convex side slopes and in coves of drainageways. They are upslope from Keswick soils. Ladoga soils formed in loess and are above the Gara and Armstrong soils. Sparta soils are very minor in extent. They are sandy and are adjacent to the major streams.

These soils have a high available water capacity.

Generally the farms are larger in this association than in others. Most of this area is in pasture. The main enterprise is the production of livestock. Some of the less sloping soils are used occasionally for cultivated crops. The principal management concern is control of erosion. Improvement of fertility is also needed.

detailed soil map units

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Killduff silty clay loam, 5 to 9 percent slopes, is one of several phases in the Killduff 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 that occur as areas so intricately mixed or so small that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Ackmore-Colo complex, 0 to 2 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. These dissimiliar soils are described in each map unit. Also, some of the more unusual or strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes some *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Quarries, limestone, is an example. Some miscellaneous areas are large enough to be delineated on the soil maps. Some that are too small to be delineated 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

5—Ackmore-Colo complex, 0 to 2 percent slopes. This complex consists of nearly level, somewhat poorly drained and poorly drained soils that are on flood plains or alluvial fans. These soils are subject to flooding. They are mainly along the lower part of tributaries that enter into bottom lands. Ackmore silt loam is next to the stream channel, and Colo silty clay loam is on lower lying bottom land. The Colo soil is between the Ackmore soil and the soils that are on the foot slopes of the adjacent uplands. The two soils in this complex are so intricately mixed on the landscape or so small in area that it is not practical to separate them in mapping. Individual areas are either irregular in shape or are long and moderately wide if they are parallel to the stream. They are mainly 10 to 60 acres in size. They are about 40 percent Ackmore silt loam and 40 percent Colo silty clay loam. The remaining 20 percent is mainly Ely, Judson, or Zook soils.

Typically, the Ackmore soil has a surface layer that is very dark grayish brown silt loam about 6 inches thick. The substratum is about 19 inches thick. It is stratified very dark gray and dark grayish brown, friable silt loam. The underlying material, a buried soil, is black silty clay loam to a depth of 60 inches.

The Colo soil has a surface layer that is black silty clay loam about 8 inches thick. The subsurface layer is black silty clay loam to a depth of 36 inches. The substratum, or underlying material, is black, very dark gray, or dark gray silty clay loam to a depth of 60 inches.

Included with this complex in mapping are Ely, Judson, and Zook soils. Ely soils are somewhat poorly drained and have 2 to 5 percent slopes. Judson soils are well drained to moderately well drained. They have 2 to 9

percent slopes. Zook soils have more clay in the subsoil and are slowly to very slowly permeable. Unless drained, the Zook soils are more subject to ponding. The included soils make up less than 20 percent of the unit.

Permeability is moderate in the Ackmore and Colo soils. Organic matter in the surface layer is 2 to 4 percent in the Ackmore soil and 4 to 8 percent in the Colo soil. These soils have a seasonal high water table. Runoff is slow. The available water capacity is high in these soils. Reaction is typically slightly acid or neutral in the surface soil. Available phosphorus in the layer below the surface soil is generally low in the Ackmore soil and medium in the Colo soil. Available potassium in both soils is very low. The shrink-swell potential is moderate for the Ackmore soil and high for the Colo soil.

Many areas of this complex are cultivated. These soils are suited to growing corn, soybeans, small grains, and grasses and legumes for hay or pasture. Most areas of these soils are suited to growing row crops intensively when they are adequately protected from flooding and are drained. Most areas are flooded before row crops are planted, which delays spring planting. Levees, dikes, and diversion terraces provide flood protection. The proper placement of subsurface and surface drains allows timely tillage and earlier seeding, especially during a wet spring. Returning crop residue to the surface or the regular incorporation of other organic material into the plow layer maintains tilth and fertility, reduces crusting, and increases water infiltration. Timely field operations are necessary to maintain good tilth.

This soil complex can be used for pasture or hay. Overgrazing causes compaction, results in poor tilth, and reduces production of desirable grasses. Proper stocking, pasture rotation, and timely deferment of grazing help keep the pasture and soil in good condition.

These soils are in capability subclass IIw.

7—Wiota silty clay loam, 0 to 2 percent slopes. This nearly level, well drained or moderately well drained soil is on convex benches along streams. This soil is rarely flooded. Individual areas are irregular in shape and generally range from 10 to 20 acres in size.

Typically the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is very dark grayish brown silty clay loam to a depth of about 21 inches. The subsoil is brown silty clay loam to a depth of about 48 inches. The substratum is brown silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of somewhat poorly drained Nevin soils in plane to slightly concave positions on the landscape. The poorly drained Bremer soils are in similar positions. They are along the edges of the area adjacent to the Zook soil. Inclusions make up less than 10 percent of the unit.

The permeability in this soil is moderate. Organic matter is 3 to 4 percent of the plow layer. The available water capacity is high. Surface runoff is medium. The shrink-swell potential is moderate. Unless the surface soil is limed, reaction is medium acid. Available phosphorus is very low, and potassium is low in the subsoil. Tilth is good.

This soil is well suited to row crops and is used extensively for corn and soybeans. It is not subject to sheet and gully erosion. It is especially suited to good management practices. A thick rooting system, returning crop residue to the surface, or the regular incorporation of organic material into the plow layer improves fertility and maintains good tilth.

This soil is well suited to hay and pasture. Hay is used more often than pasture in the cropping sequence. Alfalfa is the main crop. Warm- and cool-season grasses can be included in pasture rotation systems. Grasses and legumes increase water intake, protect the soil from wind erosion, and improve tilth. Overgrazing or grazing when the soil is too wet causes compaction and results in poor tilth. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is in capability class I.

8B—Judson silty clay loam, 2 to 5 percent slopes. This gently sloping, well drained to moderately well drained soil is on concave foot slopes at the base of steep uplands and on convex alluvial fans at the mouths of drainageways. Individual areas are long and narrow. They range from 5 to 20 acres on the foot slopes and from 5 to 10 acres on the alluvial fans.

Typically the surface layer is very dark gray silty clay loam to a depth of 9 inches. The subsurface layer is very dark grayish brown and very dark gray silty clay loam to a depth of 33 inches. The subsoil extends to a depth of 60 inches. The upper part is dark brown silty clay loam. The lower part is brown and yellowish brown silty clay loam.

Included with this soil in mapping are small areas of Ely and Colo soils. Ely and Colo soils are more poorly drained and are adjacent to drainageways that dissect the Judson soil. In some areas about 8 inches of silty overwash have been recently deposited. Inclusions make up less than 10 percent of the unit.

Permeability in this soil is moderate, and surface runoff is medium. Available water capacity is high. Organic matter in the surface layer is about 4 to 6 percent. The shrink-swell potential is moderate. Reaction in the surface layer is typically slightly acid or neutral. Available phosphorus and available potassium in the subsoil are low. Tilth is good.

This soil is used for crops, but some areas are in pasture. It is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

Because individual areas are generally small, the soil is cropped with adjacent soils. In some areas the soil receives runoff from side slopes, which causes siltation or erosion. In places this water concentrates and causes gullying. In some areas the soil is subject to flooding from small streams. The floods are of short duration.

Conservation tillage helps prevent soil loss. Diversion terraces might be needed to protect this soil from the runoff from higher lying soils. Returning crop residue to the surface and the regular incorporation of other organic material into the plow layer improve fertility and maintain good tilth.

The use of the soil for pasture or hay is also effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is in capability subclass IIe.

8C—Judson silty clay loam, 5 to 9 percent slopes. This moderately sloping, well drained to moderately well drained soil is on concave foot slopes and on convex alluvial fans that are at the outlet of drainageways. The soil is at the base of steep uplands. The slopes are typically short. Individual areas are long and narrow. They range from 5 to 15 acres on the foot slopes and from 5 to 10 acres on the alluvial fans.

Typically the surface layer is very dark gray silty clay loam to a depth of 9 inches. The subsurface layer is very dark grayish brown and very dark gray silty clay loam to a depth of 33 inches. The subsoil is silty clay loam to a depth of 60 inches. The subsoil is dark brown and friable in the upper part and brown and yellowish brown in the lower part.

Included with this soil in mapping are a few areas where about 6 inches of silty overwash has recently been deposited. In places this overwash has a higher content of sand and is lighter colored. Small gullies dissect some areas. Inclusions make up less than 10 percent of the unit.

Permeability in this soil is moderate, and surface runoff is medium. The available water capacity is high. Organic matter is about 4 to 6 percent in the surface layer. The shrink-swell potential is moderate. Reaction in the surface layer is typically slightly acid or neutral. Available phosphorus and available potassium are low in the subsoil. Tilth is good.

This soil is used mostly for crops, but some areas are in pasture. It is suitable for corn, soybeans, small grains, and grasses and legumes for hay and pasture.

Because individual areas of this soil are generally small, the soil is usually cropped with adjacent soils. It receives runoff from side slopes, which causes siltation and erosion. In places this water concentrates and causes gullying. Conservation tillage helps prevent soil loss. Gradient or diversion terraces and contour farming might be needed to protect this soil from runoff and erosion.

The use of this soil for pasture or hay is also effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is in capability subclass IIIe.

11B—Colo-Ely silty clay loams, 2 to 5 percent slopes. This complex consists of black, poorly drained Colo soils and very dark brown and black, somewhat poorly drained Ely soils. These soils are mainly along the upper reaches of the tributaries that enter into the bottom lands. Colo silty clay loam is on the low lying flood plain near the stream channel. It is subject to flooding. The Ely silty clay loam is on slight rises near the toe slopes of the uplands. The two soils are so intricately mixed on the landscape or so small in area that it is not practical to separate them in mapping. This complex is about 50 percent Colo silty clay loam and 30 percent Ely silty clay loam. The remaining 20 percent is either Zook, Judson, or Ackmore soils. Individual areas are irregular, narrow, and long, and they parallel the stream. They range from 10 to 60 acres or more in size.

Typically the Colo soil has a surface layer of black silty clay loam about 8 inches thick. The subsurface layer is black silty clay loam to a depth of about 36 inches. The next layer is very dark gray or dark gray, firm silty clay loam to a depth of 60 inches.

The Ely soil has a surface layer of very dark brown silty clay loam about 8 inches thick. The subsurface layer is black and very dark gray silty clay loam about 14 inches thick. The subsoil is grayish brown and brown, friable silty clay loam to a depth of 47 inches. The lower part of the subsoil is grayish brown and gray, friable silty clay loam to a depth of 60 inches.

Included with this complex in mapping are Judson and Zook soils. The Judson soils are well drained to moderately well drained and are on the toe slopes of the uplands. Zook soils have more clay in the subsoil and are slowly to very slowly permeabile. Unless drained, they are more subject to ponding than the Colo and Ely soils. In some places a thin overwash of silty sediments is on the surface. Inclusions make up less than 10 percent of the unit.

Permeability is moderate in Colo and Ely soils. Organic matter in the surface layer is about 4 to 8 percent in the Colo soil and 5 to 6 percent in the Ely soil. These soils have a seasonal high water table, and runoff is low or medium. The available water capacity in these soils is high. Reaction in the surface soil is neutral to medium acid. Available phosphorus in the subsoil is generally medium in the Colo soil and very low in the Ely soil. Available potassium in both soils is very low. The shrink-swell potential in the Colo soil is high. It is moderate in the Ely soil.

Many areas of these soils are cultivated. These soils are suited to corn, soybeans, small grain, and grasses and legumes for hay or pasture.

Most areas are suited to intensive row cropping if they are adequately protected from flooding and are drained.

Most flooding occurs before row crops are planted. Levees and dikes provide flood protection. The proper placement of subsurface drains and surface drains allows timely tillage and earlier seeding, especially during a wet spring. Returning crop residue to the surface or the regular incorporation of other organic material into the plow layer maintains tilth and fertility, reduces crusting, and increases infiltration of water.

These soils can be used for pasture or hay. Overgrazing causes compaction, results in poor tilth, and reduces production of desirable grasses. Proper stocking, pasture rotation, and timely deferment of grazing help keep the pasture and soil in good condition.

This complex is in capability subclass IIw.

20C—Killduff silty clay loam, 5 to 9 percent slopes. This moderately sloping, well drained and moderately well drained soil is on convex side slopes and in upper coves of drainageways. Individual areas are irregular in shape and range from 5 to 20 acres in size.

Typically the surface layer is black silty clay loam to a depth of 7 inches. The subsurface layer is very dark brown silty clay loam to a depth of 9 inches. The subsoil is brown, friable silty clay loam to a depth of 25 inches. It grades to mottled dark yellowish brown, yellowish brown, and grayish brown, friable silty clay loam and silt loam to a depth of 46 inches. To a depth of about 60 inches, the substratum is mottled grayish brown and yellowish brown silt loam with a few dark mineral accumulations.

Included with this soil in mapping are small areas of Clarinda soils at the heads of the drainageways and Colo soils that are adjacent to the drainageways. Clarinda soils are silty clay and are seepy. Colo soils are poorly drained silty clay loam. They make up about 5 percent of the unit. The total included soils make up less than 10 percent of the unit.

Permeability in the Killduff soil is moderate. Surface runoff is medium. The shrink-swell potential is moderate. Available water capacity is high. Reaction in the surface soil is neutral. Available phosphorus is medium to low, and available potassium is very low in the subsoil. Organic matter in the surface layer is 2 to 3 percent. Tilth is fair to good.

This soil is mostly cultivated and used intensively for row crops. It is suited to a cropping system of row crops rotated with oats and hay. To help control erosion, these soils need to be tilled on the contour, stripcropped, or terraced. Conservation tillage increases water intake and also helps prevent soil loss. All crop residue returned to the soil and the application of liberal amounts of other organic material into the the plow layer improve fertility and maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, which results in increased runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIIe.

20C2—Killduff silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained and moderately well drained soil is on convex side slopes and in upper coves of drainageways. Individual areas are irregular in shape and range from 5 to 20 acres in size.

Typically the surface layer is very dark grayish brown, dark brown, and brown silty clay loam to a depth of 6 inches. The subsoil is brown, friable silty clay loam to a depth of about 20 inches. This grades to mottled dark yellowish brown, yellowish brown, and grayish brown, friable silty clay loam and silt loam to a depth of about 40 inches. The substratum is mottled grayish brown, friable silt loam to a depth of 60 inches. In some areas the surface layer is darker and 9 inches or more thick.

Included with this soil in mapping are small areas of Clarinda soils at the heads of the drainageways. Inclusions make up less than 10 percent of the unit.

The permeability of the Killduff soil is moderate. Surface runoff is medium. Organic matter in the surface layer is 2 to 3 percent. The shrink-swell potential is moderate. Available water capacity is high. Reaction in the surface soil is neutral. Available phosphorus is medium to low and available potassium is very low in the subsoil.

Most areas of this soil are cultivated. This soil is suited to a cropping system of row crops rotated with oats and hay. If this soil is used for cultivated crops, further erosion is a hazard. To help control erosion, soils need to be tilled on the contour, stripcropped, or terraced. Conservation tillage increases water intake and also helps prevent excessive soil loss. The return of crop residue to the soil and the incorporation of liberal amounts of other organic material into the plow layer improve fertility and maintain good tilth. Accelerated erosion has reduced the yields of crops.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, which results in increased runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIIe.

20D2—Killduff silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained and moderately well drained soil is on convex side slopes and on head slopes of drainageways. Individual areas are irregular in shape and range from 5 to 25 acres in size.

Typically the surface layer is mixed very dark grayish brown and brown silty clay loam to a depth of about 5 inches. The subsoil is brown, friable silty clay loam to a depth of 22 inches. This grades to a mottled brown and grayish brown, friable silty clay loam to a depth of 32

inches. To a depth of about 60 inches, the substratum is mottled grayish brown, friable silt loam that contains a few dark minerals. In severely eroded areas, some dark yellowish brown silty clay loam is mixed into the surface layer. In some areas a narrow band of gray, deoxidized loess is in the subsoil.

Included with this soil in mapping are small areas of Tama soils. The Tama soils are located on small ridges within the coves of the drainageways. Inclusions make up less than 10 percent of the unit.

Permeability in this Killduff soil is moderate. Surface runoff is medium. Organic matter in the plow layer is 2 to 3 percent. The shrink-swell potential is moderate. Available water capacity is high. Reaction in the surface soil is neutral. Available phosphorus is medium to low and available potassium is very low in the subsoil.

This soil is cultivated and used for row crops. It is suited to a cropping sequence of row crops rotated with oats and hay. To help control erosion in cultivated fields, the soil needs to be tilled on the contour, stripcropped, or terraced. Row crops can be included in the rotation more often if the soil is terraced and tilled on the contour. Grassed waterways are needed to prevent formation of gullies, and in many places a terrace drop inlet could be constructed. Conservation tillage increases water intake and also reduces the hazard of erosion. Returning all crop residue to the soil and incorporating other organic material into the plow layer improve fertility and maintain good tilth. Erosion has caused a reduction in yields.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, which results in increased runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and retricted use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIIe.

24D2—Shelby loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained and well drained soil is on convex side slopes that are adjacent to drainageways. Individual areas are irregular in shape. They are usually 20 to 200 acres in size and can extend to 1 mile or more in length.

Typically the surface layer is very dark grayish brown loam about 7 inches thick. The subsoil is firm clay loam to a depth of 52 inches. It is dark brown and dark yellowish brown in the upper part, yellowish brown and brown in the middle part, and mottled grayish brown and dark yellowish brown in the lower part. The substratum is dark yellowish brown and yellowish brown, mottled, firm clay loam to a depth of 60 inches. Pebbles and stones are throughout the profile. In places the surface layer is lighter colored and 6 inches or less thick.

Included with this soil in mapping are small areas of Adair, Lamoni, and Clarinda soils. Adair soils are in similar positions on the landscape. Lamoni and Clarinda soils are on the upper parts of side slopes near the heads of drainageways. Inclusions make up less than 10 percent of the unit.

Permeability of this Shelby soil is moderately slow. The available water capacity is high. Organic matter in the plow layer is 1 to 3 percent. Surface runoff is medium. The shrink-swell potential is moderate. Reaction in the surface soil is neutral or slightly acid. Available phosphorus is low and available potassium is high in the subsoil. Tilth is fair to good.

This soil is used for and is suited to grasses, legumes, and oats. If the soil is used for cultivated crops, erosion is a hazard. If the soil is terraced, row crops can be grown part of the time. Conservation tillage on the contour and terraces increase water intake, control runoff of excess water, and help reduce soil loss. This erosion reduces yields. The return of all crop residue to the soil and the incorporation of liberal amounts of other organic material into the plow layer maintain tilth and improve fertility. Crop response is favorable with the addition of needed commercial fertilizer.

The use of this soil for pasture or hay is also effective in controlling erosion. Overgrazing or grazing where the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods keep the pasture and soil in good condition.

This soil is in capability subclass IIIe.

24E—Shelby loam, 14 to 18 percent slopes. This moderately steep, moderately well drained and well drained soil is on convex side slopes that are adjacent to drainageways. Individual areas are irregular in shape. The areas are usually 15 to 100 acres in size. They are usually less than 1 mile in length.

Typically the surface layer is black or very dark gray loam about 7 inches thick that grades into very dark grayish brown and very dark brown clay loam about 3 inches thick. The subsoil is firm clay loam to a depth of 50 inches. It is dark brown in the upper part and grades from dark yellowish brown, and yellowish brown and into brown and mottled grayish brown in the lower part. The substratum is dark yellowish brown and yellowish brown, firm, mottled clay loam to a depth of about 60 inches. Pebbles and stones are throughout the profile. In places the surface layer is lighter colored and less than 7 inches thick.

Included with this soil in mapping are narrow areas of Adair, Lamoni, Clarinda, Colo, and Ackmore soils. The Lamoni and Clarinda soils are on the upper parts of side slopes adjacent to drainageways. The Colo and Ackmore soils are adjacent to narrow drainageways that dissect some areas. Inclusions make up less than 10 percent of the unit.

Permeability of this Shelby soil is moderately slow. The available water capacity is high. Surface runoff is rapid. Organic matter in the surface layer is 3 to 4 percent. The shrink-swell potential is moderate. Reaction in the

surface layer is neutral or slightly acid. Available phosphorus is low and available potassium is high in the subsoil. Tilth is good.

This soil is used for and is suited to grasses, legumes, and oats. If the soil is used for cultivated crops, erosion is a hazard. Conservation tillage on the contour and construction of terraces where this is feasible increase water intake, control runoff of excess water, and reduce soil loss. The return of all crop residue to the surface and the application of liberal amounts of other organic material to the plow layer maintain tilth and improve fertility. Crop response generally is favorable to commercial fertilizer.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is in capability subclass IVe.

24E2—Shelby loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, moderately well drained and well drained soil is on convex side slopes that are adjacent to drainageways. Individual areas are irregular in shape. The areas are usually 15 to 100 acres or more in size and are usually from 1/2 to 1 mile or more in length.

Typically the surface layer is very dark grayish brown loam mixed with dark yellowish brown loam. It is about 6 inches thick. The subsoil is firm clay loam. It is dark brown and dark yellowish brown in the upper part. This grades into yellowish brown and grayish brown in the middle part and mottled grayish brown loam in the lower part. To a depth of 60 inches the substratum is mottled dark yellowish brown and yellowish brown, firm clay loam. Pebbles and stones are throughout the profile. In some areas the surface layer is brown loam about 6 inches thick.

Included with this soil in mapping are small areas of Adair, Lamoni, and Clarinda soils. The Adair soils are on the shoulders and noses of hills. Small areas of Lamoni and Clarinda soils are on side slopes of upper parts of heads of drainageways. These areas are clayey and usually seepy. Inclusions make up less than 10 percent of this unit.

The permeability of this Shelby soil is moderately slow. Organic matter in the surface layer is 1 to 3 percent. The available water capacity is high. Surface runoff is rapid. The shrink-swell potential is moderate. Reaction in the surface soil is neutral or slightly acid. Available phosphorus is low and available potassium is medium in the subsoil. Tilth is fair.

This soil is used for row crops, meadow, and pasture. It is suited to grasses, legumes, and oats. Generally it is not suited to corn, soybeans, or small grains because the soil is too steep.

If the soil is used for cultivated crops, erosion is a hazard. Conservation tillage on the contour reduces runoff and increases water intake. In a crop rotation system, the soil should be stripcropped. Most of it should be in small grains and meadow. The soils in this unit are generally not terraced; however erosion control structures are needed to control some gullies. In places drainageways need to be shaped and seeded. The return of crop residue to the surface and the incorporation of other organic material into the plow layer maintain tilth. The addition of commercial fertilizer is sometimes needed. The firm subsoil and moderately slow permeability are unfavorable for cultivation. If the subsoil is exposed, revegetation is difficult.

The use of this soil for pasture or hay is also effective in controlling erosion. Overgrazing or grazing when the soil is wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is in capability subclass IVe.

24F—Shelby loam, 18 to 40 percent slopes. This steep and very steep, moderately well drained and well drained soil is on convex side slopes that are adjacent to drainageways. Individual areas are irregular in shape. The areas are usually 15 to 50 acres in size and are usually less than one-half mile in length.

Typically the surface layer is very dark gray loam about 6 inches thick. The subsurface layer is very dark grayish brown clay loam about 4 inches thick. The subsoil is firm clay loam to a depth of 48 inches. It is dark brown in the upper part and grades to dark yellowish brown, yellowish brown, and brown in the lower part. The next layer is mottled yellowish brown, dark yellowish brown, and grayish brown clay loam to a depth of 60 inches. Pebbles and stones are throughout the profile.

Included with this soil in mapping are small areas of Adair, Lamoni, and Clarinda soils. The Adair soils are on the narrow shoulders and noses of hills. The Lamoni and Clarinda soils are on side slopes of the upper parts of heads of drainageways. They are clayey and usually seepy. Inclusions make up less than 10 percent of this unit.

Permeability in this Shelby soil is moderately slow. Available water capacity is high. Organic matter in the surface layer is 3 to 4 percent. Surface runoff is rapid. The shrink-swell potential is moderate. Reaction in the surface soil is neutral or slightly acid. Available phosphorus is low and available potassium is medium in the subsoil.

This soil is used for pasture, and some areas are in meadow. The soil is not suited for crops. It is best suited to pasture or woodland and provides excellent habitat for wildlife. It has suitable sites for ponds for livestock. Control of grazing is necessary to prevent serious damage to vegetation. Wooded areas need to be protected from grazing. Diversion terraces help to protect soils downslope from runoff. The operation of

farm machinery is difficult in some areas because of the steepness of slope and the presence of gullies.

This soil is in capability subclass VIe.

41C—Sparta loamy fine sand, 5 to 9 percent slopes. This moderately sloping, excessively drained soil is on convex ridges and side slopes. They are in uplands, but a few areas are on benches along streams. Individual areas are irregular in shape and range from 5 to 25 acres in size.

Typically the surface layer is very dark grayish brown loamy fine sand about 8 inches thick. The subsurface layer is very dark grayish brown loamy fine sand about 11 inches thick. The subsoil is about 22 inches thick. It is a dark brown and brown loamy fine sand. The substratum is yellowish brown sand to a depth of 60 inches. In places the surface layer is lighter in color and not as thick. In small areas the surface layer is sandy loam. In some places the surface soil is darker to a depth of 20 inches and is very fine sandy loam.

Permeability in this Sparta soil is rapid. Available water capacity is low. Surface runoff is medium. Organic matter in the surface layer is 0.5 to 1 percent. Unless the surface layer is limed, reaction is usually medium acid. Available phosphorus and available potassium are very low in the subsoil. The shrink-swell potential is low. Tilth is poor because of the low amount of organic matter and the unstable structure.

Most areas of this soil are in pasture, but some are cultivated. This soil is poorly suited to corn, soybeans, and small grains because it is droughty and low in fertility. The crop yields are low even in years of average rainfall. The soil is better suited to grasses and legumes for hay and pasture.

If this soil is used for cultivated crops, water erosion and soil blowing are hazards. Blowing sand sometimes damages newly seeded crops on this soil and adjoining soils. Conservation tillage and winter cover crops help prevent soil loss. In some places contour farming can be beneficial. The soil is poorly suited to terraces because it is highly erosive. Terraces are difficult to construct and maintain. Returning crop residue to the surface or the regular addition of other organic material to the plow layer improves fertility and maintains soil tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during dry periods help keep pasture and soil in good condition.

This soil is moderately suited to growing trees. It is droughty and needs extra water to reduce seedling mortality. Tree seeds, cuttings, and seedlings survive and grow if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

This soil is in capability subclass IVs.

41D—Sparta loamy fine sand, 9 to 18 percent slopes. This strongly sloping and moderately steep, excessively drained soil is on convex side slopes or narrow, convex ridges. This soil is in uplands. Individual areas are irregular in shape and range from 5 to 25 acres in size.

Typically the surface layer is a very dark grayish brown loamy fine sand about 9 inches thick. The subsurface layer is very dark grayish brown loamy fine sand about 5 inches thick. The subsoil is about 20 inches thick. It is dark brown, very friable loamy sand in the upper part and brown, loose loamy fine sand in the lower part. The substratum is yellowish brown sand to a depth of about 60 inches. In places the surface layer is lighter colored and not as thick. In a few areas the surface layer is sandy loam.

Permeability in this Sparta soil is rapid. Available water capacity is low. Surface runoff is medium. Organic matter in the surface layer is less than 0.5 percent. Unless the surface layer is limed, reaction is usually medium acid. Available phosphorus and available potassium are very low in the subsoil. The shrink-swell potential is low. Tilth is poor because of the low amount of organic matter and unstable structure.

Most areas are in pasture, but a few are in cultivated crops. This soil is not suited to corn and soybeans but is better suited to hay and pasture. It is droughty, is low in fertility, and has steep slopes. If this soil is used for cultivated crops, water erosion and soil blowing are severe hazards.

The use of this soil for pasture or hay is effective in controlling erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during dry periods help keep pasture and soil in good condition. The carrying capacity of pasture is low.

This soil is moderately suited to growing trees. It is droughty and requires extra water to reduce seedling mortality. Tree seeds, cuttings, and seedlings survive and grow if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

This soil is in capability subclass VIs.

43—Bremer silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on wide benches or on low second bottom lands along streams. This soil is subject to flooding in some years. Individual areas are irregular in shape and range from 10 to 30 acres in size.

Typically the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is black silty clay loam about 8 inches thick. The subsoil is 34 inches thick. The upper part is very dark gray, firm silty clay loam and silty clay. The lower part is mostly dark grayish brown, mottled, firm silty clay. The substratum is gray silty clay loam to a depth of about 60 inches.

Included with this soil in mapping are Nevin and Zook soils. Nevin soils have less clay in the subsoil and are somewhat poorly drained. The Zook soils are dark to a depth of 36 inches or more. Inclusions make up less than 10 percent of this unit.

Permeability of this Bremer soil is moderately slow. Surface runoff is slow. This soil has a seasonal high water table. Organic matter in the surface layer is 6 to 8 percent. Available water capacity is high. Reaction in the surface layer is usually slightly acid. The shrink-swell potential is high. Available phosphorus and available potassium are low in the subsoil.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. Most of this soil is suited to intensive use for row crops if drainage is adequate. The proper placement of subsurface and surface drains allows for timely tillage and earlier seeding, especially during a wet spring. Returning crop residue to the surface or the regular incorporation of other organic material into the plow layer maintains tilth and fertility, reduces crusting, and increases the rate of water intake.

This soil is suited to pasture and hay. Overgrazing causes compaction and results in poor tilth. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is suited to trees if flooding is controlled and the soil is adequately drained. Competing vegetation can be controlled or removed by site preparation or by spraying, cutting, or girdling.

This soil is in capability subclass IIw.

51—Vesser silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained or poorly drained soil is on high bottom lands, foot slopes, and fans. This soil is subject to flooding. Individual areas are elliptical and irregular in shape. They range from 4 to 15 acres in size.

Typically the surface layer is very dark gray silt loam about 8 inches thick. The subsurface layer is very dark gray and dark gray silt loam about 24 inches thick. The subsoil is dark gray and gray, friable silty clay loam to a depth of 52 inches. The substratum is gray and grayish brown silty clay loam to a depth of 60 inches.

Permeability in this Vesser soil is moderate. Available water capacity is high, and surface runoff is slow or medium. This soil has a seasonal high water table. Organic matter in the surface layer is 3 to 4 percent. Unless the surface layer is limed, reaction is medium or slightly acid. Available phosphorus is medium and available potassium is low in the subsoil. The shrink-swell potential is moderate. Tilth is good.

This more poorly drained soil usually is in small areas within larger areas of better drained soils. Most areas are cultivated. It has fair suitability for oats, hay, and pasture. It is suited to cultivated crops if drainage is adequate. Open drains and subsurface outlets are necessary to adequately drain this soil. The soil is subject to flooding by runoff from adjoining soils. It can benefit from diversions. Returning all crop residue to the surface maintains tilth.

The use of the soil for pasture or hay is effective in controlling erosion. Overgrazing, however, causes surface compaction, which, in turn, increases runoff, results in poor tilth, and reduces growth of vegetation. Proper stocking, pasture rotation, and timely deferment of grazing help keep the pasture and soil in good condition.

This soil is in capability subclass IIw.

54—Zook silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on low bottom land. It is a part of the flood plain along major streams. In some areas this soil is on flat, wet bottom lands adjacent to foot slopes and bench escarpments and is often some distance from the main stream channel. This soil is subject to flooding. Individual areas are irregular in shape and range from 15 to 70 acres in size.

Typically the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is black and very dark gray silty clay loam to a depth of 43 inches. The subsoil is about 8 inches thick. It is very dark gray, firm silty clay loam. The substratum is black and dark gray, firm silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of soils that have a surface layer of silty clay. These soils have very slow permeability. Also included are soils in small depressions or oxbows. Drainageways where surface drains have been installed are common in large areas of Zook soils. Inclusions make up less than 10 percent of this unit.

Permeability in this Zook soil is slow. Available water capacity is high. Organic matter in the surface layer is about 5 to 7 percent. Surface runoff is slow or water ponds. This soil has a seasonal high water table. Shrink-swell potential is high. Available phosphorus is low and available potassium is very low in the subsoil. Unless the surface layer is limed, reaction is usually medium acid or slightly acid.

Most areas of this soil are cultivated, but some are in pasture. This soil is well suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture if drainage is adequate and flooding is controlled. Subsurface drains generally work satisfactorily, but proper spacing of the drains is important. Subsurface drains might not be adequate in all areas because of the slow permeability of the subsoil and the lack of outlets. In some areas surface water needs to be removed by surface ditches. Returning crop residue to the surface or the regular incorporation of other organic material into the plow layer improves fertility, reduces crusting, and increases water infiltration.

If this soil is used for pasture or hay, overstocking or overgrazing causes deterioration of the water-tolerant plant community. Overgrazing when the soil is too wet causes compaction, which reduces water infiltration and results in poorer tilth. Perennial plants should have a fairly high tolerance for wetness. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition. Soil erosion generally is not a

major problem, unless the soil is disturbed and left bare and exposed for a considerable period of time or is used as a watercourse.

This soil is in capability subclass IIw.

65D—Lindley loam, 9 to 14 percent slopes. This strongly sloping, moderately well drained and well drained soil is on convex ridgetops and side slopes of valleys. Individual areas are irregular in shape and range from 5 to 20 acres in size.

Typically the surface layer is dark grayish brown and very dark gray loam about 6 inches thick. The subsurface layer is brown loam about 3 inches thick. The upper part of the subsoil is yellowish brown, firm clay loam to a depth of about 40 inches. The lower part and the substratum are yellowish brown and light brownish gray, firm clay loam to a depth of 60 inches. In a few areas the soil is eroded and has less organic matter in the surface layer. In some places slopes are less than 9 percent and the surface layer is thicker and darker.

Included with this soil in mapping are areas of soil that formed in reddish heavy clay loam or clay that is lower in organic matter and is difficult to plow or cultivate. Seep areas are common along a narrow line where the loess and glacial till come in contact. In places loess caps the narrow ridges. These included soils are less than 15 percent of this unit.

Permeability in this Lindley soil is moderately slow. Surface runoff is rapid. Organic matter in the surface layer is 1 to 2 percent. Available water capacity is high. Unless the surface soil is limed, reaction is medium to very strongly acid. Available phosphorus is medium and available potassium is low in the subsoil. The shrink-swell potential is moderate.

Most areas of this soil are in woodland or pasture. This soil is suited to growing corn, soybeans, and small grains occasionally. It is better suited for grasses and legumes for hay and pasture and is well suited to trees.

If this soil is used for cultivated crops, erosion is a hazard. Conservation tillage and grassed waterways help control soil loss. In some places contour farming and terracing help control erosion. Returning crop residue to the surface or the incorporation of other organic material into the plow layer improves fertility and maintains tilth. Crop response is generally favorable to additions of commercial fertilizer, including lime.

The use of this soil for pasture and hay is effective in controlling erosion. Overgrazing or grazing when the soil is wet causes surface compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture and soil in good condition.

This soil is moderately well suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

This soil is in capability subclass IVe.

65E—Lindley loam, 14 to 18 percent slopes. This moderately steep, moderately well drained and well drained soil is on convex ridgetops and slopes of valleys. Individual areas are irregular in shape and range from 10 to 30 acres in size.

Typically the surface layer is dark grayish brown and very dark gray loam about 6 inches thick. The subsurface layer is brown loam about 3 inches thick. The upper part of the subsoil is yellowish brown, firm clay loam to a depth of about 36 inches. The lower part and the substratum are yellowish brown and light brownish gray, firm, clay loam to a depth of 60 inches. In a few areas the soil is eroded and has less organic matter in the surface layer.

Included with this soil in mapping are a few small areas of Keswick soils that are on the upslope side of the unit. A few seep areas are located along a narrow line where the loess and the glacial till come in contact. In some places loess caps the narrow ridges. These included soils are less than 15 percent of this unit.

Permeability in this Lindley soil is moderately slow. Available water capacity is high. Surface runoff is rapid. Organic matter in the surface layer is 1 to 2 percent. Unless the surface layer is limed, reaction is medium to very strongly acid. Available phosphorus is medium and available potassium is very low in the subsoil. The shrink-swell potential is moderate. Generally tilth is poor. In cultivated areas the soil puddles or crusts after heavy rains.

Many areas of this soil are in permanent pasture or hay. This soil is poorly suited to corn, soybeans, and small grains. It is better suited to grasses and legumes for hay and pasture and trees. Cultivation should only be used to reestablish grass and legumes for hay or pasture. Returning crop residue to the surface or the incorporation of other organic material into the plow layer improves fertility, maintains tilth, and assists in establishing grasses and legumes.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture and soil in good condition.

This soil is moderately well suited to growing trees, and a few areas are reverting to timber. A plant cover should be maintained to reduce erosion. Special equipment might be needed because of the steep slopes. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

This soil is in capability subclass VIe.

65E3—Lindley soils, 14 to 18 percent slopes, severely eroded. These strongly sloping, moderately

well drained and well drained soils are on convex ridgetops and side slopes of valleys. Individual areas are irregular in shape and range from 5 to 15 acres in size.

Typically the surface layer is mixed brown and yellowish brown loam or clay loam about 6 inches thick. The subsurface layer is commonly mixed into the surface layer. The subsoil and the substratum are yellowish brown and light brownish gray, firm clay loam to a depth of 60 inches. In a few small areas the soil is darker colored and less eroded. Rills and small gullies that are 8 to 10 inches deep are prevalent after rains of high intensity.

Included with these soils in mapping are a few small areas of Keswick soils. These eroded soils are reddish heavy clay loam or clay that has very little vegetative cover. They are very low in organic matter, and it is very difficult to plow, or cultivate them, and to establish grass. Seep areas are common along a narrow line where loess and glacial till come in contact. In places loess caps the narrow ridges. These included soils and seep areas are less than 15 percent of this unit.

Permeability in these Lindley soils is moderately slow. Surface runoff is very rapid. Organic matter in the surface layer is less than 1 percent. Available water capacity is high. Unless the surface soil is limed, reaction is usually strongly acid or very strongly acid. Available phosphorus is medium and available potassium is very low in the subsoil. The shrink-swell potential is moderate. Tilth is poor.

Many areas of this soil are used for permanent pasture and hay. The soil is suited to grasses and legumes for hay and pasture. It is poorly suited to corn, soybeans, and small grains. It is too steep for efficient use of ordinary farm machinery, and there is a severe hazard of further erosion. In cultivated areas it becomes cloddy if worked wet, which results in increased runoff and retarded plant growth. Crops that require tillage should be grown only to reestablish grasses and legumes for hay and pasture. In many places erosion is so severe that establishing permanent vegetation is difficult.

The use of these soils for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture and soil in good condition.

These soils are suited to growing trees if erosion is controlled. Careful seedbed preparation is needed because the soils are severely eroded. Seedling mortality can be high. Special equipment might be needed because of the steep slopes.

These soils are in capability subclass VIIe.

65F—Lindley loam, 18 to 25 percent slopes. This steep, well drained soil is on convex, dissected side slopes. This soil is in uplands. Individual areas are moderately long, narrow bands on the lower part of the side slope. They range from 10 to 80 acres in size.

Typically the surface layer is very dark gray loam about 2 inches thick. The subsurface layer is dark grayish brown and brown loam to a depth of 9 inches. The subsoil is light brownish gray and yellowish brown, firm clay loam to a depth of about 48 inches. The substratum is mottled yellowish brown clay loam to a depth of 60 inches.

Included with this soil in mapping are small bands of Keswick soils on the upper part of the side slope. Seep areas are common where loess and glacial till come in contact. In places loess caps the upper parts of the slope. Gullies are common in this area. These included soils and areas are less than 15 percent of the unit.

Permeability in this Lindley soil is moderately slow. Available water capacity is high, and surface runoff is very rapid. The hazard of erosion is severe. Organic matter in the surface layer is about 1 percent. Unless the surface layer is limed, reaction is medium acid to very strongly acid. Available phosphorus is medium and available potassium is very low in the subsoil. The shrink-swell potential is moderate.

Much of this soil is in permanent pasture, but the steeper areas are in woodland. This soil is best suited to woodland and wildlife habitat. When it is used for pasture, the grasses best suited are trefoil and bluegrass. It is not suited for cultivated crops. Slopes are too steep for terracing. This soil has suitable sites for ponds. Control of grazing is necessary to prevent damage to vegetation and to prevent serious erosion. Use of this soil for both timber and pasture is not feasible because livestock destroy young trees and reduce growth and vigor of older trees. A plant cover should be maintained to reduce the erosion hazard. Special equipment is needed because of the steep slope.

This soil is in capability subclass VIIe.

65F3—Lindley soils, 18 to 25 percent slopes, severely eroded. These steep, well drained soils are on convex side slopes of valleys that are dissected by numerous gullies and drainageways. Individual areas are irregularly shaped and are on the lower part of the side slope. They range from 5 to 20 acres in size.

Typically the surface layer is brown and yellowish brown loam or clay loam about 6 inches thick. The subsurface layer is incorporated into the surface layer. The subsoil and the substratum are yellowish brown and light brownish gray, firm clay loam to a depth of 60 inches. In a few small areas the soil is darker and less eroded. Rill erosion is common.

Included with these Lindley soils in mapping are soils that formed in reddish clay and are low in organic matter. Seeps are common where loess and glacial till come in contact. Gullies are common in this area. The included soils and gullied areas are less than 10 percent of this unit.

Permeability in these Lindley soils is moderately slow. Surface runoff is very rapid. Erosion is a serious hazard.

Organic matter content in the surface layer is less than 1 percent. Available water capacity is high. Unless the surface soil is limed, reaction is usually strongly acid or very strongly acid. Available phosphorus is medium and available potassium is very low in the subsoil. The shrink-swell potential is moderate.

Most areas of these soils have been cultivated, but many are now in permanent pasture. These soils are not suited to corn, soybeans, small grains, and grasses and legumes for hay. They are suited to permanent pasture and woodland.

If these soils are used for cultivated crops, continued erosion is a severe hazard. Renovation of pastures is difficult because of steepness of slope. Overgrazing or grazing when the soil is too wet causes surface compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

These soils are suited to trees if erosion is controlled. A plant cover should be maintained. Special equipment is needed because of the steep slope. Careful preparation of seedbeds is needed because the soil is severely eroded and seedling mortality can be high.

These soils are in capability subclass VIIe.

65G—Lindley loam, 25 to 40 percent slopes. This very steep, well drained soil is on convex, dissected side slopes along major streams. Individual areas are long, narrow bands on the lower part of the side slope. They range from 10 to 80 acres in size.

Typically the surface layer is very dark gray loam about 2 inches thick. The subsurface layer is dark grayish brown loam to a depth of 7 inches. The subsoil is brown and yellowish brown, firm clay loam to a depth of about 46 inches. The substratum is mottled yellowish brown and light brownish gray, firm loam to a depth of 60 inches. In some places, especially at the base of steep slopes, the surface layer is more than 4 inches thick.

Included with this soil in mapping are small bands of Keswick soils on the upper part of the side slope. Seep areas are common where the loess and the glacial till come in contact. In places loess caps the upper part of the slope. Gullies are common in this area. These included soils and areas are less than 15 percent of the unit.

Permeability in this Lindley soil is moderately slow. Available water capacity is high, and surface runoff is very rapid. The hazard of erosion is severe. Organic matter in the surface layer is about 1 percent. Reaction in the surface layer is medium to very strongly acid. Available phosphorus is medium and available potassium is very low in the subsoil. The shrink-swell potential is moderate.

Much of this soil is in permanent pasture. The steeper slopes are wooded. This soil is best suited to woodland and wildlife habitat. When this soil is used for pasture, the grasses best suited are trefoil and bluegrass. The soil is not suited to cultivated crops. Slopes are too steep for terracing. This soil has suitable sites for ponds. Control of grazing is necessary to prevent damage to vegetation and prevent serious erosion. Use of this soil for both timber and pasture is not feasible because livestock destroy young trees and reduce growth and vigor of older trees. Special equipment is needed because of the steep slopes.

This soil is in capability subclass VIIe.

75—Givin silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is in slight depressions. It formed in loess on divides of uplands and on high benches adjacent to stream valleys. Individual areas are elliptical in shape and range from 5 to 20 acres in size.

Typically the surface layer is black silt loam about 7 inches thick. The subsurface layer is very dark grayish brown and very dark gray, friable silt loam about 4 inches thick. The subsoil is silty clay loam that is friable in the upper part and firm in the lower part. The upper part is dark grayish brown and grades into brown. The lower part is brown, grayish brown, and dark grayish brown over yellowish brown, grayish brown and light brownish gray.

Permeability in this Givin soil is moderately slow. Available water capacity is high. The surface runoff is slow to medium. This soil has a seasonal high water table. Organic matter in the surface layer is 2 to 4 percent. Unless the surface layer is limed, reaction is medium acid. Available phosphorus is low and available potassium is very low in the subsoil. The shrink-swell potential is moderate. Tilth is good.

Most areas of this soil are in crops. This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay or pasture. There are few limitations when the soil is used for cultivated crops. The soil has a seasonal high water table and moderately slow permeability. Open drains or properly placed subsurface drains lower the water table. The return of all crop residue to the surface maintains good tilth and improves fertility.

The use of this soil for pasture or hay helps improve water and air movement in the soil. Overgrazing or grazing when the soil is too wet causes surface compaction, which results in poor tilth. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture and soil in good condition.

This soil is in capability class I.

76B—Ladoga silt loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on convex ridgetops and side slopes. This soil is in uplands. Individual areas are irregular in shape and usually range from 10 to 50 acres in size.

Typically the surface layer is black silt loam about 8 inches thick. The subsurface layer is dark grayish brown

and grayish brown silt loam about 3 inches thick. The subsoil is brown, friable silty clay loam to a depth of about 50 inches. The substratum is grayish brown and brown friable silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Otley soils on the ridges and Clinton soils on some side slopes. These inclusions make up less than 5 percent of the unit.

Permeability in this Ladoga soil is moderately slow. Available water capacity is high. Surface runoff is medium. Organic matter in the surface layer is 2 to 3 percent. The shrink-swell potential is moderate. Reaction in the surface soil is medium acid. Available phosphorus is medium and available potassium is very low in the subsoil. Tilth is good.

Most areas of this soil are cultivated. This soil is suited to grasses, legumes, oats, and trees.

If the soil is used for cultivated crops, erosion is a hazard. Conservation tillage on the contour increases water intake. Terraces can be used to help control runoff of excess water. The return of all crop residue to the surface and the incorporation of other organic material into the plow layer maintain tilth. The addition of needed commerical fertilizer increases yields.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is suited to trees. Tree seeds, cuttings, and seedlings survive if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, or girdling.

This soil is in capability subclass IIe.

76C—Ladoga silt loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on narrow, convex ridgetops and side slopes. This soil is in the uplands. Individual areas are irregular in shape, and some are long and narrow. They range from 10 to 50 acres in size. These areas are in the southern part of the county.

Typically the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is dark grayish brown and grayish brown silt loam about 3 inches thick. The subsoil is brown, firm silty clay loam to a depth of about 48 inches. The substratum is grayish brown and brown silty clay loam to a depth of 60 inches. In places the surface layer is lighter colored and less than 7 inches thick.

Included with this soil in mapping are small areas of Clinton soils that have a thinner surface soil and contain less organic matter than the Ladoga soil. Seeps are at some heads of drainageways. Inclusions make up less than 10 percent of this unit.

Permeability in this Ladoga soil is moderately slow. Available water capacity is high. Surface runoff is medium. Organic matter in the surface layer is 2 to 3 percent. The shrink-swell potential is moderate. Reaction in the surface soil is medium acid. Available phosphorus is medium and available potassium is very low in the subsoil. Tilth is good.

Most areas of this soil are cultivated. This soil is suited to grasses, legumes, oats, and trees.

If the soil is used for cultivated crops, erosion is a hazard. Conservation tillage on the contour increases water intake. Contour stripcropping and terraces help control runoff of excess water. The return of crop residue to the surface and the incorporation of other organic material into the plow layer maintain tilth. Crop response is favorable with the addition of needed commercial fertilizer. A cropping sequence should include oats and a mixture of alfalfa and brome.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is suited to trees. Tree seeds, cuttings, and seedlings survive if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, or girdling.

This soil is in capability subclass IIIe.

76C2—Ladoga silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on narrow, convex ridgetops and side slopes. This soil is in uplands. Individual areas are irregular in shape, and some are long and narrow. They range from 10 to 50 acres in size. These areas are in the southern part of the county.

Typically the surface layer is mixed very dark gray and grayish brown silt loam about 6 inches thick. The subsoil is brown, firm silty clay loam to a depth of about 46 inches. The substratum is grayish brown and brown silty clay loam to a depth of 60 inches. In places the surface layer is very dark grayish brown silt loam about 8 inches thick. In some areas the surface layer is brown silt loam less than 8 inches thick.

Included with this soil in mapping are small areas of Clinton soils. These soils make up less than 10 percent of this unit. Their surface layer is thinner than that of the Ladoga soil. Also, it has a lower content of organic matter.

Permeability in this Ladoga soil is moderately slow. Available water capacity is high. Surface runoff is medium. Organic matter in the surface layer is 1 to 3 percent. The shrink-swell potential is moderate. Reaction in the surface soil is medium acid. Available phosphorus is medium and available potassium is very low in the subsoil. Generally tilth is good.

This soil is used for and is suited to cultivated crops, grasses, legumes, oats, and trees.

If the soil is used for cultivated crops, erosion is a hazard. The eroded Ladoga soils have lower yields than

the uneroded Ladoga soils. Conservation tillage on the contour increases water intake, and terraces help control runoff of excess water. The return of all crop residue to the surface and the incorporation of other organic material into the soil maintain tilth. Crop response is favorable with the addition of needed commercial fertilizer. A cropping sequence should include oats and a mixture of alfalfa and brome.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is suited to trees. A few small areas are in native hardwoods. Tree seeds, cuttings, and seedlings survive if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, or girdling.

This soil is in capability subclass IIIe.

76D—Ladoga silt loam, 9 to 14 percent slopes. This strongly sloping, moderately well drained soil is mainly on side slopes. This soil is in uplands. Individual areas are irregular in shape, and some are narrow and long. They usually range from 10 to 50 acres in size. These areas are in the southern part of the county.

Typically the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is dark grayish brown and grayish brown silt loam about 3 inches thick. The subsoil is brown, firm silty clay loam to a depth of about 48 inches. The substratum is grayish brown and brown silty clay loam to a depth of 60 inches. In some areas the surface layer is mixed very dark grayish brown and dark grayish brown silt loam.

Included with this soil in mapping are small areas of Clinton soils that have a thinner surface soil that contains less organic matter than that of the Ladoga soil. On some noses of hills red clay or glacial till is at the surface. Inclusions make up less than 10 percent of this unit.

Permeability in this Ladoga soil is moderately slow. Available water capacity is high. Surface runoff is medium. Organic matter in the surface layer is 2 to 3 percent. The shrink-swell potential is moderate. Reaction in the surface soil is medium acid. Available phosphorus is medium and available potassium is very low in the subsoil. Tilth is good.

This soil is used for and is suited to cultivated crops, grasses, legumes, oats, and trees.

If the soil is used for cultivated crops, there is a greater hazard of erosion than on the less sloping Ladoga soils. Conservation tillage on the contour increases water intake. Terraces are needed, and contour stripcropping also helps control runoff of excess water and erosion. The return of all crop residue to the surface and the incorporation of other organic material into the soil maintain tilth. Crop response is favorable with the addition of needed commercial fertilizer. A cropping sequence should include oats and a mixture of alfalfa and brome.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is suited to trees. Tree seeds, cuttings, and seedlings survive if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, or girdling.

This soil is in capability subclass IIIe.

76D2—Ladoga silt loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is mainly on side slopes. This soil is in uplands. Individual areas are irregular in shape, and some are narrow and long. They usually range from 10 to 50 acres in size. These areas are in the southern part of the county.

Typically the surface layer is mixed very dark grayish brown and brown silt loam about 6 inches thick. The subsoil is brown, firm silty clay loam to a depth of about 46 inches. The substratum is grayish brown and brown silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Clinton soils. In some places the erosion is so severe on noses of hills and shoulders that small areas of red clay or glacial till are at the surface. Inclusions make up less than 10 percent of this unit.

Permeability in this Ladoga soil is moderately slow. Available water capacity is high. Surface runoff is medium. Organic matter in the surface layer is 1 to 3 percent. The shrink-swell potential is moderate. Reaction in the surface soil is medium acid. Available phosphorus is medium and available potassium is very low in the subsoil. Generally tilth is good.

This soil is used for corn, soybeans, small grains, oats, grasses and legumes for meadow and pasture, and trees.

If the soil is used for cultivated crops, there is a greater hazard of erosion than on the less sloping Ladoga soils. These eroded Ladoga soils have lower yields than the uneroded ones. Conservation tillage on the contour increases water intake. Terraces and contour stripcropping help control runoff of excess water and erosion. The return of crop residue to the surface and the incorporation of other organic material into the soil maintain tilth. Crop response is favorable with the addition of needed commercial fertilizer. A cropping sequence should include oats and a mixture of alfalfa and brome.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely

deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is suited to trees, and a few small areas are in native hardwoods. Tree seeds, cuttings, and seedlings survive if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, or girdling.

The soil is in capability subclass IIIe.

80C—Clinton silt loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on ridgetops and side slopes. This soil is in uplands. Individual areas are long and irregular in shape and range from 10 to 20 acres in size.

Typically the surface layer is very dark gray silt loam about 4 inches thick. The subsurface layer is about 6 inches thick. It is dark grayish brown silt in the upper part and brown silt loam in the lower part. The upper part of the subsoil is brown and dark yellowish brown, firm silty clay loam to a depth of 26 inches. The lower part is yellowish brown, firm silty clay loam to a depth of 60 inches. In some places, slopes are less than 5 percent and the surface layer is up to 9 inches thick.

Included with this soil in mapping are small areas of Ladoga soils that are on ridgetops. These areas make up less than 5 percent of the unit.

Permeability in this Clinton soil is moderately slow. Surface runoff is medium. Organic matter in the surface layer is 1 to 2 percent. Available water capacity is high. Generally unless the surface soil is limed, reaction is medium acid. Available phosphorus is high and available potassium is very low in the subsoil. The shrink-swell potential is moderate. Tilth is good.

Most areas of this soil are in cultivated crops. This soil is suited to corn, soybeans, and small grains. It is well suited to grasses and legumes for hay and pasture.

If this soil is used for cultivated crops, erosion is a moderate hazard. Conservation tillage on the contour increases water intake. Contour stripcropping and terraces help control runoff of excess water. The return to the soil of crop residue and the incorporation of other organic material into the plow layer maintain tilth. Crop response is favorable with the addition of needed commercial fertilizer. A cropping sequence should include a meadow crop of alfalfa and brome.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

This soil is in capability subclass IIIe.

80C2—Clinton silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on ridgetops and side slopes. This soil is in the uplands. Individual areas are elongated and irregular in shape and range from 10 to 30 acres in size.

Typically the surface layer is dark grayish brown and brown silt loam about 7 inches thick. The subsoil is about 50 inches thick. The upper part is dark yellowish brown and brown, friable silty clay loam. The middle part is dark brown and grades into yellowish brown. It is firm silty clay loam. The lower part is yellowish brown, firm silty clay loam. The substratum is mottled yellowish brown silt loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Ladoga soils that are on the ridgetops. These areas make up less than 5 percent of the unit.

Permeability in this Clinton soil is moderately slow. Surface runoff is medium. Organic matter in the surface layer is less than 1 percent. Available water capacity is high. Unless the surface layer is limed, reaction is medium acid. Available phosphorus is high and available potassium is very low in the subsoil. The shrink-swell potential is moderate. Generally the tilth is fair to good.

Most areas of this soil are in cultivated crops. This soil is suited to corn, soybeans, and small grains. It is well suited to grasses and legumes for hay and pasture.

If this soil is used for cultivated crops, continued erosion is a hazard. Conservation tillage on the contour increases water intake. Contour stripcropping and terraces help control runoff of excess water. The return of crop residue to the soil and the incorporation of liberal amounts of manure into the plow layer maintain tilth. Crop response is favorable with the addition of needed commercial fertilizer. A cropping sequence should include a meadow crop of alfalfa and brome.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

This soil is in capability subclass IIIe.

80D—Clinton silt loam, 9 to 14 percent slopes. This strongly sloping, moderately well drained soil is on side slopes and on some ridgetops. This soil is in the uplands. Individual areas are elongated and irregular in shape and range from 10 to 30 acres or more in size.

Typically the surface layer is dark grayish brown silt loam about 7 inches thick. The subsurface layer is dark brown silt loam about 3 inches thick. The upper part of the subsoil is dark yellowish brown and brown, firm silty

clay loam to a depth of 26 inches. The lower part is mottled yellowish brown silty clay loam to a depth of 60 inches. In some places the surface layer is moderately eroded and lighter in color.

Included with this soil in mapping are small areas of Keswick and Lindley soils that are on the lower part of the slopes. Keswick and Lindley soils formed in glacial till. Inclusions make up less than 10 percent of this unit.

Permeability in this Clinton soil is moderately slow. Surface runoff is medium. Organic matter in the plow layer is 1 to 2 percent. Available water capacity is high. Unless the surface layer is limed, reaction is medium acid. Available phosphorus is high and available potassium is very low in the subsoil. The shrink-swell potential is moderate. Tilth is good.

Most areas of this soil are in cultivated crops. This soil is moderately suited to corn, soybeans, and small grains. It is well suited to grasses and legumes for hay and pasture and to trees.

If the soil is used for cultivated crops, erosion is a hazard. Conservation tillage on the contour increases water intake. Contour stripcropping and terraces are needed to control runoff of excess water. The return of all crop residue to the surface and the addition of liberal amounts of other organic material maintain tilth. Crop response is favorable with the addition of needed commercial fertilizer. A cropping sequence should include a meadow crop of alfalfa and brome.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled and removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

This soil is in capability subclass IIIe.

80D2—Clinton silt loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on side slopes and on some ridgetops. This soil is in uplands. Individual areas are elongated and irregular in shape and range from 10 to 40 acres or more in size.

Typically the surface layer is dark grayish brown and brown silt loam about 7 inches thick. The upper part of the subsoil is dark yellowish brown and brown, firm silty clay loam to a depth of about 20 inches. The middle part is dark yellowish brown, firm silty clay loam to a depth of 26 inches. The lower part grades into mottled yellowish-brown, firm silty clay loam to a depth of 60 inches. In some places the surface layer is darker.

Included with this soil in mapping are small areas of Keswick and Lindley soils on the lower part of the side slope. Keswick soils formed in red glacial till that is a paleosol. Lindley soils formed in glacial till. Inclusions make up less than 10 percent of this unit.

Permeability in this Clinton soil is moderately slow. Surface runoff is medium. Organic matter in the plow layer is less than 1 percent. Available water capacity is high. Unless the surface layer is limed, reaction is medium acid. Available phosphorus is high and available potassium is very low in the subsoil. Generally the shrink-swell potential is moderate in this eroded soil. Tilth is not as good as that of the uneroded soil.

Most areas of this soil are in cultivated crops. This soil is moderately suited to corn, soybeans, and small grains. It is well suited to grasses and legumes for hay and pasture and to trees.

If the soil is used for cultivated crops, erosion is a hazard. Conservation tillage on the contour increases water intake. Contour stripcropping and terraces are needed to control runoff of excess water. The return of crop residue to the surface and the incorporation of liberal amounts of other organic material into the plow layer maintain tilth. Crop response is favorable with the addition of needed commercial fertilizer. A cropping sequence should include a meadow crop of alfalfa and brome.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled and removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

This soil is in capability subclass IIIe.

80E2—Clinton silt loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, moderately well drained soil is on side slopes. This soil is in uplands. Typical areas are elongated and irregular in shape and range from 10 to 20 acres in size.

Typically the surface layer is dark grayish brown and brown silt loam about 6 inches thick. The upper part of the subsoil is dark yellowish brown and yellowish brown, firm silty clay loam to a depth of 20 inches. This grades into mottled yellowish brown, firm silty clay loam to a depth of 60 inches. In some places the surface layer is darker.

Included with this soil in mapping are small areas of Keswick and Lindley soils that are on the lower part of the slopes. Keswick and Lindley soils formed in glacial till. Inclusions make up less than 10 percent of this unit.

Permeability in this Clinton soil is moderately slow. Surface runoff is medium. Organic matter in the plow layer is less than 1 percent. Available water capacity is high. Unless the surface layer is limed, reaction is medium acid. Available phosphorus is high and available

potassium is very low in the subsoil. Generally the shrink-swell potential is moderate in this eroded soil. Tilth is fair to good.

Most areas of this soil are in cultivated crops. This soil is moderately suited to corn, soybeans, and small grains. It is well suited to grasses and legumes for hay and pasture and to trees.

If the soil is used for cultivated crops, erosion is a hazard. Conservation tillage on the contour increases water intake. Contour stripcropping and terraces are needed to control runoff of excess water. The return of crop residue to the surface layer and the addition of liberal amounts of manure maintain tilth. Crop response is favorable with the addition of needed commercial fertilizer. A cropping sequence should include a meadow crop of alfalfa and brome.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled and removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling. A plant cover should be maintained to reduce erosion. Special equipment might be needed because of the steep slopes.

This soil is in capability subclass IVe.

88—Nevin silty clay loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on low benches along streams or on second bottoms. This soil is flooded during some years. Individual areas are irregular in shape and range from 10 to 60 acres in size.

Typically the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is black and very dark gray silty clay loam about 11 inches thick. The subsoil is about 32 inches thick. The upper part and middle part are dark grayish brown, friable silty clay loam, and the lower part is grayish brown, friable silty clay loam. The substratum is grayish brown silty clay loam to a depth of 60 inches. In places, the substratum is grayish brown sandy loam.

Permeability in this Nevin soil is moderate, and surface runoff is slow. This soil has a seasonal high water table. Available water capacity is high. Organic matter in the surface layer is 4 to 5 percent. Unless the surface layer is limed, reaction is typically medium acid. The shrink-swell potential is moderate. Available phosphorus is moderate and available potassium is low in the subsoil. Tilth is fair.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

Because individual areas are generally small, they are cropped with adjacent soils in most places. The Nevin soils are in slightly higher positions than soils on the adjacent first bottoms but are flooded during some years. Areas adjacent to foot slopes can receive runoff. Subsurface drains are not normally needed but can be beneficial in some areas. Diversion terraces help prevent runoff from adjacent side slopes.

This soil is suited to hay and pasture in a cropping sequence. Hay is used more often than pasture in the cropping sequence. Alfalfa is the main crop. It is better to include both warm and cool season grasses for pasture in the rotation system. Grasses and legumes increase water intake, protect the soil from wind erosion, and improve tilth. Overgrazing or grazing when the soil is too wet causes compaction, which results in poor tilth. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is in capability class I.

93D2—Shelby-Adair complex, 9 to 14 percent slopes, moderately eroded. This complex consists of strongly sloping, well drained to somewhat poorly drained soils that are on convex side slopes. These soils are dissected and in glaciated uplands. They are in the upper reaches of the drainage system. Individual areas are usually long and narrow. They follow the contour of the side slope in a ribbon pattern. The Adair loam is on convex shoulders on the upper part of the slope, and the Shelby loam is on the convex, smooth part of the slope. It is below the Adair soils. These soils are so intermingled on the landscape or so small in area, especially the Adair soils, that it is not practical to separate them in mapping. Generally Shelby soils make up 60 percent of the area and Adair soils make up 40 percent. Individual areas range from 15 to 40 acres.

Typically the Shelby soil has a surface layer that is dark grayish brown and dark yellowish brown loam about 7 inches thick. The subsoil is 45 inches thick. It is dark brown and dark yellowish brown, firm clay loam in the upper part; yellowish brown and brown, firm clay loam in the middle part; and grayish brown, mottled, firm clay loam in the lower part. The substratum is mottled dark yellowish brown and yellowish brown clay loam to a depth of 60 inches. Pebbles and stones are throughout the profile.

The Adair soil has a surface layer that is dark grayish brown and brown clay loam about 8 inches thick. The subsoil is firm clay loam 52 inches thick. It is reddish brown in the upper part and grades to dark red, yellowish brown, and brown. A stone line is common in the upper part of the subsoil.

Included with these soils in mapping are small areas of severely eroded soils that are less than 5 acres. These soils have a thinner and lighter colored surface layer. Drainageways and gullies are common. Seeps are located where the loess and the glacial till are in contact. They are common in the heads of drainageways. These inclusions make up less than 10 percent of the unit.

The permeability is moderately slow in the Shelby soil and slow in the Adair soil. The available water capacity is high. Organic matter in the surface layer is 1 to 3 percent. Surface runoff is medium. The Adair part of this complex has a seasonal high water table. Reaction in the surface layer is neutral to slightly acid. The shrink-swell potential is high in the Adair soil and moderate in the Shelby soil. Available phosphorus is low to very low in the subsoil. Available potassium is low in the Shelby soil and is very low in the Adair soil. The tilth is generally good in the Shelby soil and is poor in the Adair soil.

Some areas of these soils are cultivated. These soils are suited to grasses, legumes, and oats.

If these soils are used for cultivated crops, erosion is a hazard. Row crops should be used in a cropping sequence only when grasses and legumes need reseeding. Conservation tillage on the contour reduces runoff and increases water intake. The return of crop residue to the surface and the addition of other organic material help to maintain tilth. Crop response is favorable with the addition of needed commercial fertilizer. Interceptor drains can be used where the soils are seepy and wet.

The use of these soils for pasture or hay is also effective in controlling erosion. These soils have suitable sites for location of ponds. Overgrazing or grazing when these soils are too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This complex is in capability subclass IVe.

93E2—Shelby-Adair complex, 14 to 18 percent slopes, moderately eroded. This complex consists of moderately steep, well drained to somewhat poorly drained soils that are on convex side slopes. These soils are dissected and in uplands. They are in the upper reaches of the drainage system. Individual areas are usually long and narrow. They follow the contour of the side slope in a ribbon pattern. The Adair clay loam is on convex shoulders on the upper part of the slope, and the Shelby loam is on the convex, smooth part of the slope. It is below the Adair soils. These soils are so intermingled on the landscape or so small in area, especially the Adair soils, that it is not practical to separate them in mapping. Generally Shelby soils make up 70 percent of the area and Adair soils make up 30 percent. Individual areas range from 15 to 40 acres.

Typically the Shelby soil has a surface layer that is dark grayish brown and brown loam about 7 inches thick. The subsoil is 45 inches thick. It is dark brown and dark yellowish brown, firm clay loam in the upper part; yellowish brown and brown, firm clay loam in the middle part; and grayish brown, mottled, firm clay loam in the lower part. The substratum is mottled dark yellowish brown and yellowish brown clay loam to a depth of 60 inches. Pebbles and stones are throughout the profile.

The Adair soil has a surface layer that is dark grayish brown and brown clay loam about 8 inches thick. The subsoil is firm clay loam 52 inches thick. It is reddish brown in the upper part and grades to dark red, yellowish brown, and brown. A stone line is common in the upper part of the subsoil.

Included with these soils in mapping are small areas of severely eroded soils that are less than 5 acres. These soils have a surface layer that is thinner and lighter colored. Drainageways and gullies are common. Seeps are located where the loess and the glacial till of the Adair soils come in contact. They are common in the heads of drainageways. These inclusions make up less than 10 percent of the unit.

Permeability in these Shelby and Adair soils is moderately slow and slow respectively. Available water capacity is high. Surface runoff is medium. The Adair part of this complex has a seasonal high water table. Organic matter in the surface layer is 1 to 3 percent. The surface layer is neutral to slightly acid depending on local liming practices. The shrink-swell potential is high in the Adair soil and moderate in the Shelby soil. Available phosphorus in the subsoil is low to very low. Available potassium is low in the Shelby soil and is very low in the Adair soil. Tilth is good in the Shelby soil and poor in the Adair soil.

Some areas of these soils are cultivated. These soils are better suited to grasses for pasture or to trees. They produce excellent habitat for wildlife. These soils have suitable sites for ponds for livestock. Overgrazing or grazing when these soils are too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This complex is in capability subclass VIe.

118—Garwin silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is in the heads of drainageways and on broad divides. This soil is in uplands. Individual areas are 10 to 160 acres or more in size.

Typically the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is black and very dark gray silty clay loam about 10 inches thick. The subsoil is friable silty clay loam to a depth of 54 inches. It is mottled very dark gray and dark gray in the upper part and grades to mottled olive gray and gray in the lower part. The substratum is mottled light olive gray silt loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Sperry soils in depressions. These areas are less than 2 acres in size. They make up 2 to 5 percent of the unit.

Permeability in this Garwin soil is moderate. The Garwin soil has a seasonal high water table. Available water capacity is high. Surface runoff is slow. Organic matter in the surface layer is 6 to 7 percent. Shrink-swell potential is high. Unless the surface layer is limed,

reaction is medium acid. Available phosphorus and available potassium in the subsoil are very low. Tilth is good.

Most areas of this soil are cultivated. This soil is well suited to corn and soybeans if it is adequately drained. The soil is also well suited to oats, hay, or pasture. The proper placement of subsurface and surface drains allows for timely tillage and earlier seeding, especially during a wet spring. Returning crop residue to the surface or the regular incorporation of other organic material into the plow layer maintains tilth and fertility, reduces crusting, and increases water infiltration. Timely field operations are necessary to maintain good tilth.

This soil is in capability subclass IIw.

119—Muscatine silty clay loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on moderately wide divides. Individual areas are 10 to 100 acres or more in size. They are in a broad, irregular pattern.

Typically the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is black silty clay loam about 10 inches thick. The subsoil is mottled dark grayish brown, friable silty clay loam to a depth of 41 inches. The substratum is mottled grayish brown silt loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Garwin soils in heads of drainageways. These areas make up 2 to 5 percent of the unit.

The permeability of this Muscatine soil is moderate. Surface runoff is slow. This soil has a seasonal high water table. Organic matter in the surface layer is 4 to 5 percent. Unless the surface layer is limed, reaction is medium acid. Available phosphorus is low and available potassium is very low in the subsoil. Available water capacity is high. The shrink-swell potential is moderate. Tilth is good.

This soil is used extensively for row crops, but legumes and oats are important rotation crops. Adequate drainage lowers a fluctuating water table. Returning crop residue to the surface or the regular incorporation of organic material into the plow layer improves fertility and helps maintain good tilth.

This soil is in capability class I.

120—Tama silty clay loam, 0 to 2 percent slopes. This well drained soil is on moderately broad divides. This soil is in uplands. Individual areas are moderately wide and are irregular in shape. They are generally 10 to 30 acres or more in size.

Typically the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is black and very dark brown silty clay loam about 11 inches thick. The subsoil is friable silty clay loam to a depth of 56 inches. It is brown and dark brown in the upper part and dark yellowish brown in the middle part. The lower part is brown and mottled grayish brown. The substratum is mottled yellowish brown and grayish brown silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Muscatine soils that are located near the center of this Tama soil. Inclusions make up less than 5 percent of this unit.

Permeability in this Tama soil is moderate. Organic matter in the surface layer is 3 to 5 percent. Available water capacity is high. Surface runoff is medium on this soil. The shrink-swell potential is moderate. Reaction in the surface soil is slightly acid. Available phosphorus is medium and available potassium is very low in the subsoil. Tilth is good.

Most areas of this soil are cultivated. This soil is well suited to corn and soybeans. It is not subject to sheet and gully erosion. This soil responds well to good management practices. Returning crop residue to the surface maintains tilth and fertility, reduces crusting, and increases water intake.

This soil is well suited to hay and pasture in a cropping sequence. Hay is used more often than pasture grasses in sequence with alfalfa. Both warm and cool season grasses for pasture should be included in a rotation system. Grasses and legumes increase water intake, protect the soil from wind erosion, and improve tilth. Overgrazing or grazing when the soil is too wet causes compaction, which results in poor tilth. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is in capability class I.

120B—Tama silty clay loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on moderately broad, convex ridgetops and on side slopes. This soil is in uplands. Individual areas are moderately wide and are irregular in shape. They are 20 to 100 acres in size.

Typically the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is black and very dark brown silty clay loam about 11 inches thick. The subsoil is friable silty clay loam to a depth of 46 inches. It is brown and dark brown in the upper part and brown and dark yellowish brown in the middle part. The lower part is mottled brown. The substratum is a mottled brown and yellowish brown silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of soils that have mottling at a depth of 18 inches. These areas are near the heads of drainageways. They do not exceed 10 percent of the delineated unit.

Permeability in this Tama soil is moderate. Available water capacity is high. Organic matter in the surface layer is 3 to 5 percent. Surface runoff is medium on this soil. The shrink-swell potential is moderate. Reaction in the surface soil is slightly acid. Available phosphorus is medium and available potassium is very low in the subsoil. Tilth is good.

Most areas of this soil are cultivated. This soil is well suited to row crops if they are in rotation with oats and hay. Erosion is a hazard. Conservation tillage, tilling on

the contour, stripcropping, and terracing help prevent soil loss. The return of crop residue to the surface and the addition of other organic material help to maintain tilth. Adequate fertilization helps increase yields. This soil responds well to a high level of management.

The use of the soil for pasture or hay is also effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which increases runoff and results in accelerated erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is in capability subclass IIe.

120C—Tama silty clay loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on convex ridgetops and moderately wide side slopes. This soil is in uplands. Individual areas are irregular in shape and range from 15 to 100 acres in size.

Typically the surface layer is black and very dark grayish brown silty clay loam about 10 inches thick. The subsoil is friable silty clay loam to a depth of 50 inches. The subsoil is a dark brown in the upper part and brown and dark yellowish brown in the middle part. The lower part is mottled brown and grayish brown. The substratum is mottled yellowish brown silty clay loam to a depth of 60 inches. In some places the surface layer is mixed very dark grayish brown and brown silty clay loam.

Included with this soil in mapping are small areas of soils that have mottling at a depth of 18 inches. These areas are at the heads of drainageways. Inclusions do not exceed 10 percent of the delineated unit.

Permeability in this Tama soil is moderate. Organic matter in the surface layer is 3 to 5 percent. Available water capacity is high. Surface runoff is medium. The shrink-swell potential is moderate. Reaction in the surface soil is slightly acid. Available phosphorus is medium and available potassium is very low in the subsoil. Tilth is good.

This soil is cultivated and is used intensively for row crops. This soil is well suited to row crops in a crop rotation system.

In cultivated fields, this soil needs to be tilled on the contour, stripcropped, or terraced to help control erosion. Conservation tillage increases water intake and also reduces the chances of erosion. Grassed waterways are needed to prevent formation of gullies, and in many places terrace drop inlets could be constructed.

The use of the soil for pasture or hay is also effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is in capability subclass IIIe.

120C2—Tama silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on narrow, convex ridges and side slopes. Individual areas are irregular in shape and range from 20 acres to several hundred acres in size.

Typically the surface layer is black silty clay loam mixed with brown silty clay loam. It is about 6 inches thick. The subsoil is friable silty clay loam to a depth of 45 inches. It is dark brown in the upper part and brown and dark yellowish brown in the middle part. The lower part is mottled brown and grayish brown. The substratum is mottled yellowish brown silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Colo and Judson soils adjacent to drainageways. Small areas of soils near heads of drainageways have gray mottling at a depth of 18 inches. In places this Tama soil is underlain by clayey sediments at shallow depths. Small areas of severely eroded soils less than 3 acres in size are on shoulders and knolls. These eroded soils have a brown surface layer of silty clay loam. Inclusions make up less than 10 percent of this unit.

Permeability in this Tama soil is moderate. Organic matter in the surface layer is 2 to 3 percent. Available water capacity is high. Surface runoff is medium. The shrink-swell potential is moderate. Reaction in the surface soil is slightly acid. Available phosphorus is medium and available potassium is very low in the subsoil. Tilth is good.

This soil is cultivated and used intensively for row crops. It is suited to corn and soybeans in rotation with oats and hay. In cultivated fields this soil needs to be tilled on the contour, stripcropped, or terraced to help control erosion. Conservation tillage increases water intake and reduces the chance of erosion. Grassed waterways are needed to prevent formation of gullies, and in many places terrace drop inlets could be constructed.

The use of the soil for pasture or hay is also effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is in capability subclass IIIe.

120D2—Tama silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on convex side slopes and nose slopes. The soil is in uplands. Individual areas are irregular in shape and range from 10 acres to several hundred acres in size.

Typically the surface layer is very dark grayish brown silty clay loam mixed with brown. It is about 5 inches thick. The subsoil is friable silty clay loam to a depth of 37 inches. The subsoil is dark brown in the upper part and brown and dark yellowish brown in the middle part.

The lower part is mottled brown and grayish brown. The substratum is mottled yellowish brown silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Colo and Judson soils adjacent to drainageways. Small areas of soils near heads of drainageways have gray mottling at a depth of 18 inches. In places this soil is underlain by clayey sediments at shallow depths. Small areas of severely eroded soils less than 3 acres in size are on knolls and shoulders. These eroded soils have a surface layer of brown silty clay loam. Inclusions make up less than 10 percent of this unit.

Permeability in this Tama soil is moderate. Organic matter content of the surface layer is 2 to 3 percent. Available water capacity is high. Surface runoff is medium. The shrink-swell potential is moderate. Reaction in the surface soil is slightly acid. Available phosphorus is medium and available potassium is very low in the subsoil. Tilth is good.

This soil is cultivated and is used intensively for row crops. It is suited to corn and soybeans in a cropping sequence with oats and hay. There is a greater hazard of erosion than in less sloping Tama soils. In cultivated fields the soil needs to be tilled on the contour, stripcropped, or terraced to help control erosion. Terracing is more difficult on these steeper slopes. Grassed waterways are needed to prevent formation of gullies, and in many places terrace drop inlets can be constructed. Conservation tillage increases water intake and also reduces the hazard of erosion.

The use of the soil for pasture and hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is in capability subclass IIIe.

122—Sperry silt loam, 0 to 1 percent slopes. This level, very poorly drained or poorly drained soil is on broad divides. This soil is in uplands. It is subject to ponding. Individual areas are mainly nearly circular in shape, but some are elongated. Most areas range from 2 to 8 acres in size.

Typically the surface layer is black silt loam about 11 inches thick. The subsurface layer is dark gray and gray silt loam about 7 inches thick. The subsoil is firm and friable silty clay and silty clay loam to a depth of 50 inches. It is mottled dark gray in the upper part and gray in the middle part. The lower part is mottled gray and olive gray. The substratum is mottled gray silty clay loam to a depth of 60 inches.

Permeability in this Sperry soil is very slow or slow. Organic matter in the surface layer is about 3 to 4 percent. The shrink-swell potential is high. Available water capacity is high. Surface runoff is very slow. This soil has a seasonal high water table. Reaction in the surface layer is slightly acid or neutral. Available phosphorus and potassium are very low in the subsoil. Water is ponded in these areas during wet seasons. Tilth is moderately good.

Some areas of this soil are cultivated; others are idle. This soil is moderately well suited to row crops if it is adequately drained. Since areas are small, this soil is farmed with the surrounding soils. Artificial drainage is required. Surface drainage is needed to remove ponded water. The clayey subsoil makes subsurface drainage difficult. Adequate drainage allows for timely tillage and earlier seeding, especially during a wet spring. Returning crop residue to the surface or the regular incorporation of other organic material into the plow layer maintains tilth and fertility, reduces crusting, and increases water infiltration. Timely field operations are necessary to maintain good tilth.

This soil is in capability subclass IIIw.

133—Colo silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on flood plains, low benches, and alluvial fans. It is subject to flooding. In the large valleys individual areas of this soil range from about 5 acres to 100 acres or more in size. They are broad and irregular in shape. In small valleys the areas are long and narrow and are about 5 to 20 acres in size.

Typically the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is black silty clay loam to a depth of 36 inches. The substratum is very dark gray and dark gray silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Ely, Judson, and Zook soils. Ely soils have a dark grayish brown subsoil at a depth of about 30 inches. They are somewhat poorly drained. Judson soils are dark brown at a depth of about 30 inches and are well drained to moderately well drained. Zook soils have more clay in the solum than Colo soils. Inclusions make up less than 10 percent of this unit.

Permeability in this Colo soil is moderate, and surface runoff is slow. This soil has a seasonal high water table. Organic matter in the surface layer is about 4 to 8 percent. The surface layer is neutral. It has high available water capacity. Available phosphorus is medium and available potassium is very low in the subsoil. The shrink-swell potential is high. Tilth is fair.

Most areas of this soil are in crops, but some are in pasture. If this soil is drained, it is suited to corn, soybeans, and grasses and legumes for hay and pasture. In some areas the soil is subject to runoff from side slopes, which causes siltation. In places this water concentrates and causes gullying. Other areas are subject to short periods of flooding from small streams. Most flooding occurs before row crops are planted, which delays spring planting. Levees, dikes, and drainage provide flood protection. Returning crop reside to the surface or the incorporation of organic material into the plow layer maintains tilth and fertility, reduces

crusting, and increases water infiltration. Timely field operations are necessary to maintain good tilth.

The use of the soil for pasture or hay is also effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which increases runoff. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is in capability subclass IIw.

133+—Colo silt loam, overwash, 0 to 2 percent slopes. This nearly level, poorly drained soil is on flood plains and in narrow drainageways. The soil is in uplands. It is subject to flooding. Individual areas are broad and irregular or elongated in shape and range from 10 to 100 acres in size.

Typically the surface layer is stratified black, very dark grayish brown, and dark grayish brown silt loam about 8 inches thick. The subsurface layer is black silty clay loam about 36 inches thick. The substratum is very dark gray silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Ackmore soils that have stratified surface and subsurface layers which, combined, are 20 inches or more thick and some small areas of concave Zook soils that have a higher clay content. Inclusions make up less than 10 percent of this unit.

Permeability in this Colo soil is moderate. Organic matter in the surface layer is about 3 to 5 percent. Available water capacity is high. Surface runoff is very slow, or the soil is ponded. This soil has a seasonal high water table. Reaction in the surface layer is neutral. Available phosphorus is medium and available potassium is very low in the subsoil. The shrink-swell potential is high. Tilth is fair.

Some areas of this soil are cultivated; some are in pasture. This soil is suited to corn, soybeans, and grasses and legumes for hay and pasture if it is drained and protected from flooding. Spring plowing and planting can be delayed because of flooding. This soil benefits from artificial drainage. Because the surface layer is silt loam, plowing and preparation of a seedbed is easier in this soil than in the other Colo soils. Diversion terraces constructed on soils upslope protect this Colo soil from siltation. Returning crop residue to the surface or the regular incorporation of other organic material into the plow layer improves fertility and maintains good tilth.

If this soil is used for pasture or hay, overgrazing or grazing when the soil is too wet causes surface compaction, which increases runoff and results in poor tilth. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIw.

162B—Downs silt loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on convex ridgetops and side slopes. This soil is in uplands. Individual areas are irregular in shape and range from 5 to more than 40 acres.

Typically the surface layer is very dark gray silt loam about 8 inches thick. The subsurface layer is dark grayish brown, friable silt loam to a depth of 13 inches. The subsoil is friable silty clay loam to a depth of 60 inches. The upper part is dark brown to brown, and the lower part is brown and yellowish brown and has a few grayish brown mottles. In some areas the surface layer is lighter colored and less than 8 inches thick.

Permeability in this Downs soil is moderate. Organic matter in the surface layer is 3 to 4 percent. Available water capacity is high. Surface runoff is medium. The shrink-swell potential is moderate. Unless the surface layer is limed, reaction is medium acid. Available phosphorus is medium and available potassium is very low in the subsoil. Tilth is good.

Most areas of this soil are cultivated. This soil is suited to row crops if they are rotated with small grains and hay. When row crops are grown, tilling on the contour and stripcropping or terracing and conservation tillage are needed to help prevent soil loss. The return of all crop residue to the surface and the incorporation of liberal amounts of other organic material into the plow layer maintain fertility and tilth. These soils respond well to a high level of management.

The use of this soil for pasture or hay is also effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which increases runoff and erosion. Proper stocking rates, pasture rotations, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

This soil is in capability subclass IIe.

162C2—Downs silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on convex ridges and side slopes. This soil is in uplands. Individual areas are irregular in shape and range from 10 to 85 acres in size.

Typically the surface layer is mixed very dark grayish brown and brown silt loam about 5 inches thick. In many places plowing has mixed the former subsoil material into the surface layer. The subsoil is brown and yellowish brown, friable silty clay loam to a depth of 60 inches. It has a few grayish brown mottles at a depth of 30 to 60 inches. In places the surface layer is brown silt loam and is 5 inches or less in thickness.

Permeability in this Downs soil is moderate. Organic matter in the surface layer is 1 to 3 percent. Available water capacity is high. Surface runoff is medium. The shrink-swell potential is moderate. Unless the surface

layer is limed, reaction is medium acid. Available phosphorus is medium and available potassium is very low in the subsoil. Tilth is good.

Most areas of this soil are cultivated. This soil is suited to a cropping sequence of corn, soybeans, and small grain. It is well suited to grasses and legumes. Continued erosion is a hazard. In cultivated fields this soil needs to be tilled on the contour, stripcropped, or terraced to help control erosion. Conservation tillage increases water intake and also reduces the chances of erosion. The return of crop residue to the surface and the incorporation of liberal amounts of other organic material into the plow layer maintain fertility and tilth. Grassed waterways are needed to prevent formation of gullies, and in many places terrace drop inlets could be constructed.

The use of this soil for pasture or hay is also effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which increases runoff and erosion. Proper stocking, pasture rotations, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to growing trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

This soil is in capability subclass IIIe.

162D—Downs silt loam, 9 to 14 percent slopes. This strongly sloping, well drained soil is mainly on convex side slopes. It is in uplands. Individual areas are irregular in shape and generally range from 10 to 60 acres in size.

Typically the surface layer is very dark gray silt loam about 5 inches thick. The subsurface layer is dark grayish brown silt loam to a depth of 11 inches. The subsoil is brown and yellowish brown, friable silty clay loam to a depth of 60 inches. It has a few grayish brown mottles in the lower part. In some places, this soil has a thinner surface layer.

Included with this soil in mapping are small areas of poorly drained Colo soils, somewhat poorly drained Ely soils, and well drained Gara soils. The Colo and Ely soils are in drainageways. The Gara soils have a loam surface layer and are on side slopes on lower parts of the landscape. Inclusions make up 10 to 15 percent of the unit.

Permeability in this Downs soil is moderate. Available water capacity is high. Surface runoff is medium. Organic matter in the surface layer is 3 to 4 percent. Unless the surface layer is limed, reaction is medium acid. Available phosphorus is medium and available potassium is very low in the subsoil. The shrink swell potential is moderate. Tilth is good.

This soil is used for row crops, small grains, woodland, and pasture. It is suited to row crops if they are in a cropping sequence with oats, hay, grass, and legumes.

In cultivated fields this soil needs to be tilled on the contour, stripcropped or terraced to help control erosion. Row crops can be included in a cropping system more often if soils are terraced and tilled on the contour. Grassed waterways are needed to prevent formation of gullies, and in many places terrace drop inlets are constructed. Conservation tillage increases water intake and also reduces the hazard of erosion. The return of crop residue to the surface and the incorporation of liberal amounts of other organic material into the plow layer maintain fertility and tilth.

The use of this soil for pasture or hay is also effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, which increases runoff and erosion. Proper stocking, pasture rotations, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling. Use of this soil for both timber and pasture is not feasible because livestock destroy young trees and reduce growth and vigor of older trees.

This soil is in capability subclass IIIe.

162D2—Downs silt loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is mainly on convex side slopes and nose slopes. This soil is in uplands. Individual areas are 10 to 100 acres or more in size.

Typically the surface layer is mixed very dark grayish brown and brown silt loam about 6 inches thick. Plowing has mixed some former subsoil material into the surface layer. The subsoil is brown and yellowish brown, friable silty clay loam to a depth of about 60 inches. It has a few grayish brown mottles at a depth of 30 to 60 inches. In some areas, the surface layer is brown silt loam.

Permeability in this Downs soil is moderate. Organic material in the surface layer is 1 to 3 percent. Available water capacity is high. Surface runoff is medium. The shrink-swell potential is moderate. Unless the surface layer is limed, reaction is medium acid. Available phosphorus is medium and available potassium very low in the subsoil. Tilth is good.

Most areas of this soil are cultivated. This soil is suited to row crops if it is used in a cropping sequence with oats, grasses, and legumes. Continued erosion is a hazard. In cultivated fields this soil needs to be tilled on the contour, stripcropped, or terraced to help control erosion. Row crops can be included in the cropping system more often if soils are terraced and tilled on the contour. Grassed waterways are needed to prevent formation of gullies, and in many places terrace drop inlets could be constructed. Conservation tillage, as well as other conservation practices, increases water intake

and also reduces the hazard of erosion. The return of crop residue to the surface and the incorporation of liberal amounts of other organic material into the plow layer maintain fertility and tilth.

The use of this soil for pasture or hay is also effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

This soil is in capability subclass IIIe.

163C—Fayette silt loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on narrow, convex ridgetops and side slopes. This soil is in uplands. Individual areas are irregular in shape. They are long and narrow. They range from 10 to 50 acres in size.

Typically the surface layer is very dark gray silt loam 3 inches thick. The subsurface layer is dark gray, dark grayish brown, and brown silt loam 9 inches thick. The subsoil is friable silty clay loam to a depth of 51 inches. It is brown in the upper part, dark yellowish brown in the middle part, and yellowish brown in the lower part. The substratum is yellowish brown silty clay loam to a depth of 60 inches.

Included with this soil in mapping are a few small areas of Downs soils. Seeps are in some heads of drainageways. Inclusions make up less than 10 percent of the unit.

Permeability in this Fayette soil is moderate. Organic matter in the surface layer is 1 to 2 percent. Available water capacity is high. Surface runoff is medium. The shrink-swell potential is moderate. Reaction in the surface layer is medium acid, slightly acid, or neutral. Available phosphorus is high and available potassium is very low in the subsoil. Tilth is good.

This soil is mostly cultivated and is used intensively for row crops. It is suited to grasses, legumes, oats, and trees.

If the soil is used for cultivated crops, erosion is a hazard. Conservation tillage on the contour increases water intake. Contour stripcropping and terraces help control runoff of excess water. The return of crop residue to the surface and the incorporation of other organic material into the plow layer maintain tilth. The addition of needed commercial fertilizer increases yields. A cropping sequence should include oats and a mixture of alfalfa and brome.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

This soil is in capability subclass IIIe.

163C2—Fayette silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on narrow, convex ridgetops and side slopes. This soil is in uplands. Individual areas are long, narrow, and irregular in shape. They range from 10 to 50 acres in size.

Typically the surface layer is mixed brown and dark grayish brown silt loam about 6 inches thick. The subsoil is friable silty clay loam to a depth of 50 inches. It grades from brown to dark yellowish brown to yellowish brown. The substratum is yellowish brown silty clay loam to a depth of about 60 inches. In places the surface layer is brown silty clay loam that is 6 inches or less in thickness.

Included with this soil in mapping are a few small areas of Downs soils. They are on the same part of the landscape as the Fayette soil. Inclusions make up less than 10 percent of the unit.

Permeability in this Fayette soil is moderate. Organic matter in the surface layer is less than 1 percent. Available water capacity is high. Surface runoff is medium. The shrink-swell potential is moderate. Reaction in the surface layer is medium acid, slightly acid, or neutral. Available phosphorus is high and available potassium is very low in the subsoil. Tilth is good.

This soil is mostly cultivated and is used intensively for row crops. This soil is suited to cultivated crops, grasses, legumes, oats, and trees.

If the soil is used for cultivated crops, erosion is a hazard. Conservation tillage on the contour increases water intake. Contour stripcropping and terraces help to control runoff of excess water. Grassed waterways are needed to prevent formation of gullies, and in many places terrace drop inlets could be constructed. The return of crop residue to the surface and the addition of other organic material help to maintain tilth. Crop response is favorable with the addition of needed commercial fertilizer. A cropping sequence should include oats and a mixture of alfalfa and brome.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

This soil is in capability subclass IIIe.

163D2—Fayette silt loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on narrow ridgetops and side slopes. This soil is in uplands. Individual areas are long, narrow, and irregular in shape and range from 10 to 30 acres in size.

Typically the surface layer is mixed brown and dark grayish brown silt loam about 6 inches thick. The subsoil is friable silty clay loam to a depth of 50 inches. It grades from brown to dark yellowish brown, then to yellowish brown. The substratum is yellowish brown silty clay loam to a depth of about 60 inches. In some places the surface layer is brown silty clay loam that is 10 inches or less in thickness.

Included with this soil on similar landscapes are a few small areas where a red clayey glacial till is at the surface. Inclusions make up less than 10 percent of the unit.

Permeability in this Fayette soil is moderate. Organic matter in the surface layer is less than 1 percent. Available water capacity is high. Surface runoff is medium. The shrink-swell potential is moderate. Reaction in the surface layer is medium acid, slightly acid, or neutral. Available phosphorus is high and available potassium is very low in the subsoil. Tilth is good.

This soil is mostly cultivated and is used intensively for row crops. It is suited to cultivated crops, grasses, legumes, oats, and trees.

If the soil is used for cultivated crops, erosion is a hazard. Conservation tillage on the contour increases water intake. Contour stripcropping and terraces help to control runoff of excess water. Grassed waterways are needed to prevent the formation of gullies. In many places terrace drop inlets could be constructed. The return of crop residue to the surface and the incorporation of other organic material into the plow layer help to maintain tilth. Crop response is favorable with the addition of needed commercial fertilizer. A cropping sequence should include oats and a mixture of alfalfa and brome.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and results in poor tilth. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

This soil is in capability subclass IIIe.

163E2—Fayette silt loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, well drained soil is on convex side slopes. It is in uplands. Individual areas are irregular in shape. They are long and narrow and are in bands on the upper part of the side slopes. They range from 10 to 25 acres in size.

Typically the surface layer is mixed brown and dark grayish brown silt loam about 6 inches thick. The subsoil is friable silty clay loam to a depth of 48 inches. It grades from brown to dark yellowish brown, then to yellowish brown. The substratum is yellowish brown silty clay loam to a depth of about 60 inches. In some places the surface layer is brown silty clay loam 6 inches or less in thickness.

Included in mapping this soil are a few small areas where a red clayey till is at the surface. Inclusions make up less than 10 percent of this unit.

Permeability in this Fayette soil is moderate. Organic matter in the surface layer is less than 1 percent. Available water capacity is high. Surface runoff is rapid. The shrink-swell potential is moderate. Reaction in the surface soil is medium acid, slightly acid, or neutral. Available phosphorus is high in the subsoil and available potassium is very low. Tilth is good.

This soil is used for row crops, small grains, meadow, and pasture. It is poorly suited to cultivated crops and, in most places, is better suited to hay or pasture. This soil ordinarily is not too well suited to corn and oats, except when grasses and legumes need to be reseeded. It is susceptible to severe sheet and gully erosion. Slopes are generally too steep for terracing; therefore, fields used for corn can be stripcropped and tilled on the contour to reduce erosion. Conservation tillage helps to reduce runoff and increase water intake. It is not desirable to substitute soybeans for corn in the rotation. The return of crop residue to the surface and the incorporation of other organic material into the plow layer help to maintain tilth. Crop response is favorable with the addition of needed commercial fertilizer. Some of the seeps at the heads of drainageways can be controlled by drains. Erosion control structures are needed in some gullies and drainageways.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is moderately well suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling. A plant cover should be maintained to reduce erosion. Special equipment might be needed because of the steep slopes.

This soil is in capability subclass IVe.

179D—Gara loam, 9 to 14 percent slopes. This strongly sloping, well drained to moderately well drained

soil is on upland side slopes adjacent to drainageways. Individual areas are long and irregular. They generally are on the lower two-thirds of the slope. They usually range from 10 to 50 acres in size.

Typically the surface layer is very dark gray loam about 6 inches thick. The subsurface layer is dark grayish brown loam 4 inches thick. The subsoil is firm clay loam to a depth of about 45 inches. It is brown, yellowish brown, and dark yellowish brown. The substratum is yellowish brown and mottled grayish brown clay loam to a depth of 60 inches. In places the surface layer is lighter colored and 6 inches or less thick.

Included with this soil in mapping are small areas where red clay is on the surface. In places loess caps the narrow ridges. Seepy areas in short drainageways are common. Inclusions make up less than 10 percent of this unit.

Permeability in this Gara soil is moderately slow. Organic matter in the surface layer is 2 to 3 percent. Available water capacity is high. Surface runoff is medium. The shrink-swell potential is moderate. Reaction in the surface soil is medium or slightly acid. Available phosphorus is very low to low and available potassium is very low in the subsoil. Tilth is good.

Some areas of this soil are cultivated; however, most areas are in woodland. This soil is suited to cultivated crops, but in most places it is better suited to hay or pasture because it is susceptible to severe sheet and gully erosion. Slopes are generally too steep for terracing; therefore, fields used for corn need to be stripcropped and tilled on the contour. Conservation tillage reduces runoff and increases water intake. Soybeans are not a desirable substitute for corn in a crop rotation system. The return of crop residue to the surface and the incorporation of liberal amounts of other organic material into the plow layer maintain tilth. Many of the small gullies and drainageways have seeps. Installing subsurface drains in seeps prior to shaping and seeding the gullies into grassed waterways controls wetness. Erosion control structures are needed in some gullies and drainageways.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods keep the pasture and soil in good condition.

This soil is suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

This soil is in capability subclass IVe.

179D2—Gara loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained to moderately well drained soil is on side slopes adjacent to drainageways. This soil is in uplands. Individual areas are long and irregular in shape. They are generally on the lower two-thirds of the slope. They usually range from 15 to 100 acres or more in size.

Typically the surface layer is dark grayish brown and yellowish brown loam about 6 inches thick. The subsoil is brown and yellowish brown, firm clay loam about 39 inches thick. The substratum is yellowish brown and mottled grayish brown clay loam to a depth of about 60 inches. In places the surface layer is lighter colored and less than 6 inches thick.

Included with this soil in mapping are small areas where a red clay is at the surface. In places loess caps the narrow ridges. Seepy areas in the small gullies and drainageways are common. Inclusions make up less than 10 percent of this unit.

Permeability in this Gara soil is moderately slow. Organic matter in the surface layer is 1 to 3 percent. Available water capacity is high. Surface runoff is medium. The shrink-swell potential is moderate. Unless the surface soil is limed, reaction is medium acid or slightly acid. Available phosphorus is very low to low and available potassium is medium in the subsoil. Tilth is good.

This soil is used for row crops, small grains, meadow, and pasture. It is poorly suited to cultivated crops. In most places it is better suited to hay or pasture because it is susceptible to severe sheet and gully erosion. Slopes are generally too steep for terracing; therefore, fields used for corn need to be stripcropped and tilled on the contour. Conservation tillage reduces runoff and increases water intake. The return of crop residue to the surface and the addition of other organic materials maintain tilth. The small gullies and drainageways that have seeps benefit by subsurface drains and by being shaped and seeded into grassed waterways. Erosion control structures are needed in some gullies and drainageways.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

This soil is in capability subclass IVe.

179E—Gara loam, 14 to 18 percent slopes. This moderately steep, well drained soil is on side slopes adjacent to drainageways. This soil is in uplands. Individual areas are long and irregular. They are generally on the lower two-thirds of the slope. They usually range from 15 to 100 acres or more in size.

Typically the surface layer is very dark gray loam about 5 inches thick. The subsurface layer is dark

grayish brown and brown loam to a depth of 11 inches. The subsoil is clay loam to a depth of about 43 inches. It is firm and brown, dark yellowish brown, and yellowish brown in the upper part. The lower part of the subsoil and the substratum are yellowish brown and mottled grayish brown to a depth of about 60 inches. In some areas the surface layer is eroded and is mixed very dark gray and brown loam.

Included with this soil in mapping are small areas of Lindley soils. Seepy areas at the heads of short drainageways are common. Inclusions make up less than 10 percent of this unit.

Permeability in this Gara soil is moderately slow. Organic matter in the surface layer is 2 to 3 percent. Available water capacity is high. Surface runoff is rapid. The shrink-swell potential is moderate. Unless the surface soil is limed, reaction is medium acid or slightly acid. Available phosphorus is very low to low and available potassium is very low in the subsoil.

This soil is used for row crops, small grains, meadow, and pasture. It is poorly suited to cultivated crops. In most places it is better suited to hay or pasture because it is susceptible to severe sheet and gully erosion. The small gullies and drainageways that have seeps benefit by subsurface drains and by being shaped and seeded into grassed waterways. Erosion control structures are needed to control some gullies and drainageways.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition. These areas have suitable sites for ponds for livestock.

This soil is suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling. A plant cover should be maintained to reduce erosion. Special equipment might be needed because of the steep slopes.

This soil is in capability subclass VIe.

179E2—Gara loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, well drained soil is on side slopes adjacent to drainageways. This soil is in uplands. Individual areas are long and irregular in shape. They are generally on the lower two-thirds of the slope. They range from about 15 to 100 acres or more in size.

Typically the surface layer is dark grayish brown and yellowish brown loam about 6 inches thick. The subsoil is yellowish brown, firm clay loam. The substratum is yellowish brown and mottled grayish brown clay loam to a depth of about 60 inches. In places the surface layer is lighter colored and less than 6 inches thick.

Included with this soil in mapping are small areas where red clay is at the surface. These areas are on similar parts of the landscape. Seepy areas in the gullies and drainageways are common. Inclusions make up less than 10 percent of this unit.

Permeability in this Gara soil is moderately slow. Organic matter in the surface layer is 1 to 3 percent. Available water capacity is high. Surface runoff is rapid. The shrink-swell potential is moderate. Unless the surface soil is limed, reaction is medium or slightly acid. Available phosphorus is very low to low and available potassium is low in the subsoil.

This soil is used for row crops, small grains, meadow, and pasture. It is poorly suited to cultivated crops. In most places it is better suited to hay or pasture because it is susceptible to severe sheet and gully erosion. Slopes are too steep for terracing. Some of the seeps at the heads of drains can be controlled by subsurface drainage. Erosion control structures are needed in some gullies and drainageways.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling. A plant cover should be maintained to reduce erosion. Special equipment might be needed because of the steep slopes.

This soil is in capability subclass VIe.

179F—Gara loam, 18 to 25 percent slopes. This steep, well drained soil is on side slopes adjacent to drainageways. This soil is in uplands. Individual areas are long and irregular in shape. They generally are on the lower two-thirds of the slope. They range from 20 to 70 acres in size.

Typically the surface layer is very dark gray loam about 8 inches thick. The subsurface layer is dark grayish brown loam to a depth of 10 inches. The subsoil is yellowish brown, firm clay loam to a depth of 40 inches. The substratum is yellowish brown and mottled grayish brown clay loam to a depth of 60 inches. In places the surface layer is eroded and is mixed very dark gray and brown loam.

A few small areas of Lindley soils are included with this unit in mapping. Seepy areas at the heads of short gullies and drainageways are common. Inclusions make up less than 10 percent of this unit.

Permeability in this Gara soil is moderately slow. Organic matter in the surface layer is 2 to 3 percent. Available water capacity is high. The surface runoff is rapid. The shrink-swell potential is moderate. Unless the surface soil is limed, reaction is usually medium acid or slightly acid. Available phosphorus is very low to low and available potassium is low in the subsoil.

This soil is used for pasture and trees. It is best suited to pasture or trees and provides excellent habitat for wildlife. Some areas have suitable sites for ponds for livestock. Overgrazing or grazing when the soil is too wet causes compaction, which, in turn, increases runoff and accelerates erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; if possible, by prescribed burning; or by spraying, cutting, and girdling. A plant cover should be maintained to reduce erosion. Special equipment might be needed because of the steep slopes.

This soil is in capability subclass VIe.

192D2—Adair clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained to somewhat poorly drained soil is on shoulders of convex side slopes. Individual areas of this unit are narrow bands 200 to 300 feet wide. They range from 5 to 30 acres in size.

Typically the surface layer is black and very dark grayish brown clay loam about 8 inches thick. The subsoil is 52 inches thick. It is very dark gray and reddish brown, friable clay loam in the upper part and grades to dark yellowish brown and dark red, firm clay in the middle part. The lower part is yellowish brown and brown, firm clay loam. A line of small stones and coarse gravel is common in the upper part of the subsoil. In places the surface layer is very dark gray and reddish brown clay loam.

Permeability in this Adair soil is slow. Organic matter in the surface layer is about 1 to 3 percent. When this soil is cultivated, surface runoff is medium. This soil has a seasonal high water table. The shrink-swell potential and available water capacity are high. Reaction in the surface layer is neutral. Available phosphorus is very low and available potassium is very low to low in the subsoil. The surface layer is difficult to till when eroded because of the clayey subsoil. Root development is restricted somewhat by the clayey layer in the upper part of the subsoil.

Most areas of this soil are cultivated. This soil is better suited to grasses, legumes, and oats.

If the soil is used for cultivated crops, erosion is a hazard. Row crops can be used in a crop rotation when grasses and legumes need reseeding. Conservation tillage on the contour reduces runoff and increases water intake. The return of crop residue to the surface and the incorporation of other organic material and needed commercial fertilizer into the plow layer maintain tilth and fertility. Interceptor drains can be used in areas of seepy and wet soil.

The use of this soil for hay or pasture is effective in controlling erosion. Compaction by machinery or by grazing under wet conditions is a problem with this soil. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture or hay in good condition.

This soil is moderately well suited to poorly suited to trees. Erosion is a hazard. Some small areas have scattered existing stands of trees, but the trees are generally of low quality.

This soil is in capability subclass IVe.

220—Nodaway silt loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on first bottom lands adjacent to major streams and tributaries and is on alluvial fans. This soil is subject to flooding. Individual areas that parallel the stream are long and moderately wide and are 10 to 80 acres in size. In areas where the stream has been straightened, Nodaway soils are adjacent to the old channels.

Typically the surface layer is very dark grayish brown silt loam and a few thin strata of grayish brown and dark grayish brown silt loam. It is about 7 inches thick. The substratum is very dark grayish brown silt loam to a depth of 38 inches. It is stratified with lenses. The underlying layer is black silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Ackmore and Colo soils. There are small areas of soils that have concave slopes. These soils are wet or have a seasonal, fluctuating water table. Inclusions make up less than 10 percent of this unit.

Permeability in this Nodaway soil is moderate, and surface runoff is slow. This soil has a seasonal high water table. Organic matter is 2 to 4 percent. The soil on the large bottom lands is occasionally flooded, but it is rarely flooded on the alluvial fans. Reaction in the surface layer and the substratum is typically neutral. Available phosphorus and available potassium are generally medium in the substratum. Tilth is good. The shrink-swell potential is moderate.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Most areas of this soil are suited to intensive row cropping if adequately protected from flooding. The soil is flooded before corn is planted. Levees and dikes provide protection from flooding. The return of crop residue to the surface and the addition of liberal amounts of other organic material maintain fertility and tilth.

This soil is well suited to trees if competing vegetation is controlled or removed. This can be accomplished by site preparation or by spraying, cutting, or girdling.

This soil is in capability subclass IIw.

222C—Clarinda silty clay loam, 5 to 9 percent slopes. This moderately sloping, poorly drained soil is on side slopes and in coves at the heads of drainageways. Individual areas are in a narrow and irregular pattern. They are less than 20 acres in size.

Typically the surface layer is very dark gray silty clay loam about 6 inches thick. The subsurface layer is very dark grayish brown silty clay loam 4 inches thick. The subsoil is firm silty clay to a depth of 60 inches. It is very dark gray and dark gray in the upper part, and the lower part is mottled gray.

Included with this soil on the lower part of the slopes are small areas of Olmitz soils. In some places local alluvium mantles the clayey sediments in the drainageways. Seep areas are located where the loess and the glacial till are in contact. Inclusions make up less than 10 percent of this unit.

Permeability in the Clarinda soil is very slow. Organic matter in the surface layer is 3 to 4 percent. Available water capacity is high. Surface runoff is medium to rapid. This soil has a seasonal high water table. Reaction in the surface layer is neutral. Available phosphorus is low and available potassium is low to medium in the subsoil. Tilth is poor because of high clay content and the seepage. The shrink-swell potential is high.

This soil is mainly used for hay, which is effective in controlling erosion. This soil is poorly suited to cultivated crops. It is difficult to work when wet and warms up slowly in the spring. Some areas are too wet for alfalfa. In places this soil is better suited to legumes and grasses tolerant to wetness than to alfalfa and brome. This soil is not suited to subsurface drains, but interceptor drains placed in adjacent soils upslope reduce wetness. Gullies and drainageways need to be shaped and seeded into grassed waterways.

This soil is in capability subclass IVw.

222C2—Clarinda silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, poorly drained soil is on convex side slopes and in coves at the heads of drainageways. Individual areas are in a narrow and irregular pattern. They are less than 20 acres in size.

Typically the surface layer is very dark gray and dark gray silty clay loam about 8 inches thick. The subsoil is firm silty clay to a depth of 60 inches. It is very dark gray and dark gray in the upper part; the lower part is a mottled gray.

Included with this soil on the lower part of the slopes are small areas of Olmitz soils. In some places local alluvium mantles the clayey sediments in the drainageways. Seeps are located where the loess and the glacial till are in contact. Inclusions make up less than 10 percent of this unit.

Permeability in this Clarinda soil is very slow. Organic matter content in the surface layer is 2 to 3 percent. Available water capacity is high. Surface runoff is medium to rapid. This soil has a seasonal high water table. Reaction in the surface layer is neutral. Available phosphorus is low and available potassium is low to medium in the subsoil. Tilth is poor because of the high clay content and the seepage. The shrink-swell potential is high.

This soil is mainly used for hay, which is effective in controlling erosion. This soil is poorly suited to cultivated crops. It is difficult to work when wet and warms up slowly in the spring. Some areas are too wet for alfalfa. In places this soil is better suited to legumes and grasses tolerant to wetness than to alfalfa and brome. Seedbed preparation is more difficult on this Clarinda soil than on the uneroded areas. This soil is not suited to subsurface drains, but interceptor drains placed in adjacent soils upslope reduce wetness. Gullies and drainageways need to be shaped and seeded into grassed waterways.

This soil is in capability subclass IVw.

222D2—Clarinda silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, poorly drained soil is in narrow bands on the upper part of side slopes and in coves at the heads of drainageways. Individual areas are narrow bands on side slopes but are irregular in shape within coves. They are 5 to 15 acres in size.

Typically the surface layer is very dark gray and dark gray silty clay loam about 5 inches thick. The subsoil is firm silty clay loam and silty clay to a depth of 60 inches. It is very dark gray and dark gray in the upper part and mottled gray in the lower part. In places the surface layer is very dark gray silty clay loam about 10 inches thick.

Included with this soil in mapping are small areas of alluvial soils in the narrow drainageways. Seeps are located where the loess and the glacial till come in contact. Inclusions make up less than 10 percent of this unit.

Permeability in this Clarinda soil is very slow. Organic matter in the surface layer is 1 to 3 percent. Surface runoff is medium to rapid. This soil has a seasonal high water table. Reaction in the surface layer is neutral. Available water capacity is high. Available phosphorus is low and available potassium is low to medium in the subsoil. Tilth is poor because of the firm clay and the seepage. Shrink-swell potential is high.

This soil is used mainly for hay and pasture, which is effective for controlling erosion. Conservation tillage on the contour reduces runoff and increases water intake. Seedbed preparation is very difficult. Returning crop residue to the surface and the incorporation of other organic material into the plow layer help to maintain tilth and fertility. Interceptor drains can be used in seepy and wet areas. Drainageways might need to be shaped and seeded into grassed waterways.

This soil is in capability subclass IVe.

273B—Olmitz loam, 2 to 5 percent slopes. This gently sloping, well drained to moderately well drained soil is on alluvial fans at or near the mouth of drainageways in uplands and on slightly concave to plane foot slopes. Individual areas are narrow and irregular in shape. They generally range from 5 to 20 acres in size.

Typically the surface layer is very dark grayish brown loam about 7 inches thick. The subsurface layer is very dark brown clay loam about 23 inches thick. The subsoil is friable clay loam to a depth of 60 inches. The upper part of the subsoil is very dark grayish brown, and the lower part is dark brown. In places the surface layer is clay loam or silt loam.

Permeability in this Olmitz soil is moderate. Organic matter in the surface layer is about 4 to 6 percent. The shrink-swell potential is moderate. Reaction in the surface layer is typically neutral. Available water capacity is high. Available phosphorus and available potassium are generally very low in the subsoil. Tilth is good.

Most areas of this soil are cultivated. This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If the soil is used for cultivated crops, there is a hazard of erosion and the formation of a few gullies. In many places this soil receives deposition of sediments from steeper, adjacent soils upslope. A diversion terrace is often constructed above this soil to reduce the hazard of sheet erosion by diverting run-on water from the higher soils. Conservation tillage and grassed waterways help prevent excessive soil loss. Returning crop residue to the surface or the regular incorporation of other organic material into the plow layer improves fertility and maintains good tilth.

The use of the soil for pasture and hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is in capability subclass IIe.

273C—Olmitz loam, 5 to 9 percent slopes. This moderately sloping, well drained to moderately well drained soil is on plane or concave foot slopes at the base of steep glacial till uplands. Individual areas are narrow and irregular in shape. They generally range from 5 to 15 acres in size.

Typically the surface layer is very dark grayish brown loam about 7 inches thick. The subsurface layer is very dark brown clay loam about 23 inches thick. The subsoil is friable clay loam to a depth of 60 inches. The upper part of the subsoil is very dark grayish brown, and the lower part is dark brown.

Included with this soil in mapping are some small areas of Shelby and Gara soils. These soils are also on foot slopes. They make up less than 10 percent of this unit.

Permeability in this Olmitz soil is moderate. Organic matter in the surface layer is about 4 to 6 percent. The shrink-swell potential is moderate. Reaction in the surface layer is typically neutral. Available water capacity is high. Available phosphorus and available potassium are generally very low in the subsoil. Tilth is good.

Some areas of this soil are cultivated. The soil adjacent to steeply sloping uplands is commonly used for native bluegrass pasture. This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If the soil is used for cultivated crops, there is a hazard of erosion and formation of gullies. In most places this soil receives deposition of sediments from steeper, adjacent soils upslope. A diversion terrace is often constructed above this soil to reduce the hazard of sheet erosion and gullying by diverting run-on water from the steeper slopes. Conservation tillage on the contour, terraces, and grassed waterways help prevent excessive soil loss. Returning crop residue to the surface or the regular incorporation of other organic material into the plow layer improves fertility and maintains good tilth.

The use of the soil for pasture and hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods keep the pasture and soil in good condition.

This soil is in capability subclass IIIe.

279—Taintor silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on broad divides. This soil is in uplands. Individual areas of this soil are long. Some are broad and have irregular boundaries. They range from 10 to over 80 acres in size.

Typically the surface layer is black silty clay loam about 6 inches thick. The subsurface layer is black silty clay loam about 11 inches thick. The subsoil is firm silty clay and silty clay loam to a depth of 47 inches. It is mottled very dark grayish brown in the upper part and gradually grades to olive gray and light olive gray in the lower part. The substratum is mottled light olive gray silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of very poorly drained or poorly drained Sperry soils. These soils are in depressions. On the small slight rises or convex slopes are somewhat poorly drained Mahaska soils. Inclusions make up less than 10 percent of this unit.

Permeability in this Taintor soil is moderately slow. Surface runoff is slow. This soil has a seasonal high water table. Organic matter in the surface layer is 4 to 5 percent. Available water capacity is high. Reaction in the surface layer generally is slightly acid. Available phosphorus and potassium are very low in the subsoil. In places water remains on the surface during wet periods. The shrink-swell potential is high. Under proper moisture conditions tilth is good, but it is poor if the soil is tilled when too wet or too dry.

This soil can be cultivated and used intensively for row crops if adequate drainage is provided. It is well suited to corn and soybeans. The soil is also suited to oats, hay, or pasture. It is not subject to sheet or gully erosion. The

return of crop residue to the surface and the incorporation of other organic material into the plow layer maintain fertility and tilth.

This soil is in capability subclass IIw.

280—Mahaska silty clay loam, 1 to 3 percent slopes. This nearly level, somewhat poorly drained soil is on moderately long and wide divides. Individual areas of this unit are in a broad, irregular pattern. They are 10 to 100 acres or more in size.

Typically the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is black and very dark gray silty clay loam about 13 inches thick. The subsoil is firm silty clay loam to a depth of 60 inches. It is dark grayish brown in the upper part, grayish brown in the middle part, and light olive gray and olive gray in the lower part. The lower part of the subsoil has yellowish brown and strong brown mottles and dark oxides.

Included with this soil in mapping are small areas of poorly drained Taintor and Sperry soils on the lower part of the landscape and the moderately well drained Otley soils on low convex rises. Inclusions make up less than 10 percent of this unit.

Permeability in this Mahaska soil is moderate. Surface runoff is slow. This soil has a seasonal high water table. Unless the surface soil is limed, reaction is slightly acid. Organic matter in the surface layer is 4 to 5 percent. Available phosphorus is medium and available potassium is very low in the subsoil. The shrink-swell potential is moderate. Available water capacity is high. Tilth is good.

This soil is used extensively for and is well suited to corn and soybeans. Including legumes and oats in the cropping sequence is important. Adequate drainage controls a fluctuating water table. Erosion is not a problem. The return of crop residue to the surface and the incorporation of liberal amounts of other organic material into the plow layer maintain fertility and tilth.

This soil is in capability class I.

281B—Otley silty clay loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil in on moderately broad, convex ridgetops and side slopes. This soil is in uplands. Individual areas are moderately wide and long and are 20 to 100 acres in size.

Typically the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is black and very dark grayish brown, friable silty clay loam about 10 inches thick. The subsoil is friable silty clay loam to a depth of 60 inches. It is brown in the upper part, yellowish brown in the middle part, and grayish brown and yellowish brown in the lower part.

Included with this soil in mapping are small areas of Mahaska and Taintor soils that are at the heads of drainageways. These soils do not exceed 15 percent of the delineated unit.

Permeability in this Otley soil is moderate. Available water capacity is high. Organic matter in the surface layer is 3 to 4 percent. Surface runoff is medium. The shrink-swell potential is moderate. Reaction in the surface layer is usually neutral. Available phosphorus is low and available potassium is very low in the subsoil. Tilth is good.

Most areas of this soil are cultivated. This soil is well suited to corn and soybeans, but erosion is a hazard. A cropping sequence should include oats and a mixture of alfalfa and brome. When row crops are grown, often in a crop rotation, conservation tillage, tilling on the contour, stripcropping, or terracing helps to prevent soil loss. The return of crop residue to the surface maintains tilth, and adequate fertilization increases yields. This soil responds well to a high level of management.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is in capability subclass IIe.

281C—Otley silty clay loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on convex ridgetops and moderately wide side slopes. This soil is in uplands. Individual areas are longer than they are wide and are irregular in shape. They range from 15 to 60 acres in size.

Typically the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is black and dark grayish brown silty clay loam about 8 inches thick. The subsoil is friable silty clay loam to a depth of 60 inches. It is brown in the upper part, yellowish brown in the middle part, and grayish brown in the lower part.

Included with this soil in mapping are small areas of Judson soils adjacent to the narrow drainageways. In some places seeps are at the heads of drainageways. Inclusions make up less than 10 percent of the unit.

Permeability in this Otley soil is moderate. Available water capacity is high. Organic matter in the surface layer is 3 to 4 percent. Surface runoff is medium. The shrink-swell potential is moderate. Reaction in the surface soil is neutral. Available phosphorus is low and available potassium is very low in the subsoil. Tilth is good.

Most areas of this soil are cultivated. This soil is well suited to corn and soybeans, grasses, legumes, oats, and trees.

If the soil is used for cultivated crops, erosion is a hazard. Conservation tillage on the contour increases water intake. Terraces help control runoff of excess water. The return of crop residue to the surface and the incorporation of other organic material into the plow layer maintain tilth. Crop response is favorable with the addition of needed commercial fertilizer. A cropping sequence should include oats and a mixture of alfalfa and brome.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil

is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is in capability subclass IIIe.

281C2—Otley silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on convex ridgetops and moderately wide side slopes. This soil is in uplands. Individual areas are longer than they are wide and are irregular in shape. They range from 15 to 100 acres in size.

Typically the surface layer is mixed very dark grayish brown and very dark brown silty clay loam that is 8 inches thick. The subsoil is friable silty clay loam to a depth of 60 inches. It is brown in the upper part, yellowish brown in the middle part, and grayish brown in the lower part.

Included with this soil in mapping are small areas of Judson soils adjacent to the narrow drainageways. In some places seeps are at the heads of drainageways. Inclusions make up less than 10 percent of this unit.

Permeability in this Otley soil is moderate. Organic matter in the surface layer is 2 to 3 percent. Available water capacity is high. Surface runoff is medium. The shrink-swell potential is moderate. Reaction in the surface layer is neutral. Available phosphorus is low and available potassium is very low in the subsoil. Tilth is good.

This soil is mostly cultivated and used intensively for row crops, small grains, and meadow. It is suited to corn and soybeans. Erosion is a hazard. A cropping sequence should include oats and a mixture of alfalfa and brome. Where row crops are grown, often in a rotation system, conservation tillage, tilling on the contour, stripcropping, or terracing are needed to prevent soil loss. Return of crop residue to the surface maintains tilth. Crop response is favorable with adequate fertilization. This soil responds well to a high level of management.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is in capability subclass IIIe.

281D2—Otley silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on convex side slopes. This soil is in uplands. Individual areas are long, narrow, and irregular in shape. Each area usually ranges from 10 to 40 acres in size.

Typically the surface layer is mixed very dark gray and brown silty clay loam about 7 inches thick. The subsoil is friable silty clay loam to a depth of 60 inches. The upper part is brown, the middle part is yellowish brown, and the lower part is grayish brown.

Included with this soil in mapping are seeps that usually are at the heads of drainageways. Inclusions make up less than 5 percent of this unit.

Permeability in this Otley soil is moderate. Organic matter in the surface layer is 2 to 3 percent. Available water capacity is high. Surface runoff is medium. The shrink-swell potential is moderate. Reaction in the surface layer is medium acid to neutral. Available phosphorus is low and available potassium is very low in the subsoil. Tilth is good.

Most areas of this soil are cultivated. This soil is moderately suited to corn and soybeans. Erosion is a hazard. A cropping system should include oats and a mixture of alfalfa and brome. If row crops are grown often in the rotation sequence, conservation tillage, tilling on the contour, stripcropping, or terracing are needed to prevent soil loss. Return of crop residue to the surface maintains tilth. Crop response is favorable with adequate fertilization. This soil responds well to a high level of management.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is in capability subclass IIIe.

291—Atterberry silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on loess-mantled divides. This soil is in uplands. Individual areas are broad and wide and irregular in shape. They range from 10 to 30 acres or more in size.

Typically the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is grayish brown silt loam. The subsoil is silty clay loam to a depth of about 54 inches. The upper part is brown and firm, the middle part is grayish brown and firm, and the lower part is grayish brown and light olive brown and is friable. The substratum is light gray and light olive brown silt loam to a depth of about 60 inches. In places the subsoil is heavier textured.

Included with this soil in mapping are small areas of soils which are in depressions and which are poorly drained. Inclusions make up less than 5 percent of this unit.

Permeability in this Atterberry soil is moderate. Available water capacity is high. Surface runoff is medium. This soil has a seasonal high water table. Organic matter in the surface layer is 3 to 4 percent. Shrink-swell potential is moderate. Reaction in the surface layer is slightly acid. Available phosphorus is low and available potassium is very low in the subsoil.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, small grains, and grasses. It responds well to a high level of management. Adequate drainage controls a fluctuating water table. The return of all crop residue to the surface and the incorporation of

liberal amounts of other organic material into the plow layer maintain fertility and tilth.

This soil can be used for pasture or hay. A cropping sequence that includes legumes for meadow is important. Erosion is not a problem. Overgrazing or grazing when the soil is too wet causes compaction, which results in poor tilth. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

A few small areas are in native hardwoods. Tree seedlings and cuttings survive and grow well if competing vegetation is controlled. Proper site preparation is essential to grow trees.

This soil is in capability class I.

293D2—Chelsea-Ladoga complex, 9 to 14 percent slopes, moderately eroded. This complex consists of strongly sloping, moderately well drained and excessively drained soils on ridgetops and side slopes. These soils are in uplands. They mainly border the North Skunk River and Sugar Creek. Individual areas range from 10 to 20 acres in size. They are about 60 percent Chelsea soils and 30 percent Ladoga soils. These soils are so intricately mixed or so small in area that it is not practical to separate them in mapping.

Typically the Chelsea soil has a surface layer that is very dark grayish brown and brown loamy fine sand about 7 inches thick. The subsurface layer is 36 inches thick. It is brown loamy fine sand in the upper part and yellowish brown fine sand in the lower part. The next layer is a yellowish brown and brown fine sand and narrow bands of brown sandy loam to a depth of 60 inches.

Typically the Ladoga soil has a surface layer that is very dark gray and brown silt loam about 6 inches thick. The subsoil is brown, friable silty clay loam to a depth of about 46 inches. The substratum is grayish brown and brown silty clay loam to a depth of about 60 inches.

Included with these soils in mapping are soils that are severely eroded. These soils have less organic matter and are lower in fertility than the Chelsea and Ladoga soils. Inclusions make up less than 10 percent of this unit.

Permeability is rapid in the Chelsea soil and moderately slow in the Ladoga soil. Available water capacity is low in the Chelsea soil and high in the Ladoga soil. Surface runoff for both soils is medium and rapid. Organic matter in the surface layer is less than 0.5 percent in the Chelsea soil and 1 to 3 percent in the Ladoga soil. Shrink-swell potential is low in the Chelsea soil and moderate in the Ladoga soil. Reaction in the surface layer is slightly acid or neutral in the Chelsea soil and medium acid in the Ladoga soil. Available phosphorus and available potassium are very low in the Chelsea subsoil. Available phosphorus is medium and available potassium is very low in the Ladoga subsoil.

Most areas of these soils are in woodland or pasture. These soils are poorly suited to corn, soybeans, and small grains because they are droughty and low in fertility. Row crops generally are grown only when grasses and legumes need to be reseeded.

If these soils are used for cultivated crops, erosion is a hazard. The Chelsea soils are subject to soil blowing and should be protected by a plant cover at all times.

The use of these soils for pasture or hay is effective in controlling erosion. Overgrazing or grazing when Ladoga soil is too wet causes surface compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during dry periods help keep pasture and soil in good condition.

These soils are moderately well suited to trees. A few small areas are in native hardwoods. The Chelsea soil is droughty, and extra water is needed to reduce seedling mortality. Tree seeds, cuttings, and seedlings survive if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

These soils are in capability subclass VIs.

293E2—Chelsea-Ladoga complex, 14 to 18 percent slopes, moderately eroded. This complex consists of moderately steep, moderately well drained and excessively drained soils on side slopes. They mainly are on the border of uplands adjacent to North Skunk River and Sugar Creek. They are in the southwest part of the county. Individual areas of this map unit range from 10 to 20 acres in size and are made up of about 60 percent Chelsea loamy fine sand and about 30 percent Ladoga silt loam. These soils are so intricately mixed that it is not practical to separate them in mapping.

Typically the Chelsea soil has a surface layer that is dark grayish brown and brown loamy fine sand about 6 inches thick. The subsurface layer is loamy fine sand and fine sand to a depth of 36 inches. It is brown in the upper part and yellowish brown in the lower part. The next lower layer is yellowish brown and brown, loose fine sand and narrow bands of brown sandy loam to a depth of 60 inches.

Typically the Ladoga soil has a surface layer that is very dark gray and brown silt loam about 6 inches thick. The subsoil is brown, friable silty clay loam to a depth of 46 inches. The substratum is grayish brown and brown silty clay loam to a depth of 60 inches.

Included with these soils in mapping are small areas of soils that are severely eroded. These soils are on side slopes too. They have less organic matter and are lower in fertility. Inclusions make up less than 10 percent of this unit.

Permeability is rapid in the Chelsea soil and is moderately slow in the Ladoga soil. Available water capacity is low in the Chelsea soil and high in the Ladoga soil. Surface runoff for both soils is rapid. Organic matter in the surface layer is less than 0.5 percent in the Chelsea soil and 1 to 3 percent in the Ladoga soil. The shrink-swell potential is low for the

Chelsea soil and is moderate for the Ladoga soil. Reaction in the surface layer is slightly acid or neutral in the Chelsea soil and is medium acid in the Ladoga soil. Available phosphorus and available potassium are very low in the Chelsea subsoil. Available phosphorus is medium and available potassium is very low in the Ladoga subsoil.

Most areas of these soils are in pasture and trees. These soils are poorly suited to crops. They are moderately steep, droughty, and low in fertility. The best use of the soils is for pasture or woodland.

The use of these soils for pasture is effective in controlling erosion. Overgrazing or grazing when the Ladoga soil is too wet causes surface compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during dry periods keep pasture and soil in good condition.

These soils are moderately suited to trees, and a few small areas are in native hardwoods. A plant cover should be maintained to reduce erosion. Special equipment might be needed because of the steep slopes. The Chelsea soil is droughty, and at times extra water is needed to reduce seedling mortality.

This soil is in capability subclass VIIs.

293F—Chelsea-Ladoga complex, 18 to 25 percent slopes. This complex consists of steep, moderately well drained and excessively drained soils on side slopes. These soils mainly are on the border of uplands adjacent to North Skunk River and Sugar Creek. They are in the southwestern part of the county. Individual areas of this complex are about 20 acres in size. They are made up of about 65 percent Chelsea loamy fine sand and 30 percent Ladoga silt loam. These soils are so intricately mixed that it is not practical to separate them in mapping.

Typically the Chelsea soil has a surface layer that is dark brown loamy fine sand about 6 inches thick. The subsurface layer is loamy fine sand and fine sand to a depth of about 36 inches. It is brown in the upper part and yellowish brown in the lower part. The next lower layer is yellowish brown and brown fine sand and narrow bands of brown sandy loam to a depth of 60 inches.

Typically the Ladoga soil has a surface layer that is very dark gray silt loam about 6 inches thick. The subsurface layer is dark grayish brown and grayish brown silt loam about 3 inches thick. The subsoil is brown, friable silty clay loam to a depth of 46 inches. The substratum is grayish brown and brown silty clay loam to a depth of about 60 inches.

Included with these soils in mapping are Chelsea and Ladoga soils that are eroded and have a thinner surface layer. They are also on the side slopes. Inclusions make up less than 5 percent of this unit.

Permeability is rapid in the Chelsea soil and is moderately slow in the Ladoga soil. Available water capacity is low in the Chelsea soil and is high in the Ladoga soil. Surface runoff for both soils is rapid. Organic matter content in the surface layer is less than 0.5 percent in the Chelsea soil and 1 to 3 percent in the Ladoga soil. The shrink-swell potential is low in the Chelsea soil and is moderate in the Ladoga soil. Reaction in the surface layer is slightly acid or neutral in the Chelsea soil and is medium acid in the Ladoga soil. Available phosphorus and available potassium are very low in the Chelsea subsoil. Available phosphorus is medium and available potassium is very low in the Ladoga subsoil.

Most areas are in pasture or woodland and these are the best uses for the soils. The slopes are steep. The soils are droughty and low in fertility.

The use of these soils for pasture is effective in controlling erosion. Overgrazing or grazing when the Ladoga soil is too wet causes surface compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during dry periods help keep the pasture and soil in good condition.

These soils are suited to trees, and a few small areas are in native hardwoods. A plant cover should be maintained to reduce erosion. Special equipment might be needed because of the steep slopes. The Chelsea soil is droughty, and at times extra water is needed to reduce seedling mortality.

These soils are in capability subclass VIIs.

377C2—Dinsdale silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on convex side slopes. This soil is in uplands. Individual areas of this unit are generally 5 to 20 acres in size. They are irregular in shape.

Typically the surface layer is mixed very dark grayish brown and brown silty clay loam about 6 inches thick. The subsoil is about 36 inches thick. The upper part is dark brown and brown, friable silty clay loam. The middle part is brown, friable loam. The lower part is yellowish brown, friable loam. The substratum is yellowish brown loam to a depth of about 60 inches. In some places the surface layer is thicker and darker, and in others the silty material is 42 inches or more thick.

Included with this soil in mapping are small areas of Liscomb soils. Liscomb soils formed in loamy till and are on the sloping nose slopes and side slopes. Inclusions make up less than 10 percent of this unit.

Permeability of this Dinsdale soil is moderate, but the upper part of the subsoil is more permeable than the lower part and the substratum. Available water capacity is high, and surface runoff is medium. During extended, very wet periods, a perched water table causes seeps on some side slopes. Organic matter in the surface layer is 2 to 3 percent. Reaction in the surface layer is neutral. Available phosphorus is low and available potassium is very low in the subsoil. Shrink-swell potential is moderate. Tilth is fair.

Most areas of this soil are in crops. This soil is well suited to corn and soybeans if they are used in rotation

with oats and hay. In cultivated fields this soil needs to be tilled on the contour, stripcropped, or terraced to help control erosion. Conservation tillage increases water intake and also reduces erosion. Grassed waterways are needed to prevent formation of gullies, and in some places terrace drop inlets could be constructed. The return of crop residue to the surface and the incorporation of liberal amounts of other organic material into the plow layer maintain fertility and tilth.

The use of this soil for pasture or hay is also effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods keep the pasture and soil in good condition.

This soil is in capability subclass IIIe.

377D2—Dinsdale silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on convex side slopes. This soil is in uplands. Individual areas of this unit are generally 5 to 15 acres in size. They are irregular in shape.

Typically the surface layer is mixed very dark grayish brown and brown silty clay loam about 6 inches thick. The subsoil is about 36 inches thick. The upper part is dark brown and brown friable silty clay loam. The middle part is brown friable silty clay loam. The lower part is yellowish brown loam. The substratum is yellowish brown loam to a depth of about 60 inches. In some places the loess is 42 inches or more thick. In others, the surface layer is very dark brown silty clay loam about 10 inches thick.

Included with this soil in mapping are small areas of Liscomb soils and spots of sandy soils. Liscomb soils formed in loamy till and are on the steeper slopes. A few sandy areas are on the high part of the side slope, have lower available water capacity, and are subject to severe soil blowing. Inclusions make up less than 10 percent of this unit.

Permeability in this Dinsdale soil is moderate, but the upper part of the subsoil is more permeable than the lower part and the substratum. Available water capacity is high, and surface runoff is rapid. During wet periods a perched water table causes seeps on some side slopes. Organic matter in the surface layer is 1.5 to 2.5 percent. Reaction in the surface layer is neutral. Available phosphorus is low and available potassium is very low in the subsoil. The shrink-swell potential is moderate. Tilth is fair.

Most areas of this soil are in crops. This soil is suited to corn and soybeans if they are used in rotation with oats and hay.

In cultivated fields this soil needs to be tilled on the contour, stripcropped, or terraced to help control erosion. In some places terraces are difficult to construct. Row crops can be included in the cropping system more often if the soils are terraced and tilled on the contour. Conservation tillage increases water intake and also reduces the hazard of erosion. Grassed waterways are needed to prevent formation of gullies, and in some places terrace drop inlets can be constructed. The return of all crop residue to the surface and the addition of liberal amounts of other organic material maintain fertility and tilth.

The use of this soil for pasture or hay is also effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods keep the pasture and soil in good condition.

This soil is in capability subclass IIIe.

422—Amana silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on wide bottoms and high, old, natural levees along streams. This soil is subject to flooding. Individual areas of this unit are irregular in shape and range from 5 to 20 acres in size.

Typically the surface layer is black silt loam about 7 inches thick. The subsurface layer is black and very dark brown silt loam about 8 inches thick. The subsoil is friable silt loam to a depth of 55 inches. It is dark grayish brown in the upper part and grayish brown in the lower part. The substratum, is grayish brown silt loam to a depth of about 60 inches.

Included with this soil in mapping are small areas of Ackmore, Colo, Nodaway, and Vesser soils. The Colo soils are slightly lower on the landscape and are poorly drained. The Ackmore and Nodaway soils are adjacent to the main stream and have marked evidence of recent deposits of sediment in the upper 24 to 40 inches. Vesser soils are within the meander belt of the stream and are on lower parts of the landscape. Inclusions make up less than 15 percent of this unit.

Permeability in this Amana soil is moderate, and surface runoff is slow. This soil has a seasonal high water table. Organic matter in the surface layer is 3.5 to 4.5 percent. Available water capacity is high. Reaction in the surface layer is neutral. Available phosphorus is low and available potassium is very low in the subsoil. The surface layer is friable and easily tilled through a fairly wide range of moisture content. It has a moderate shrink-swell potential.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. Most areas are suited to intensive use for row crops if this soil is adequately protected from flooding. Levees and dikes are beneficial in providing flood protection. The proper placement of subsurface drains and surface drains allows timely tillage and earlier seeding, especially during a wet spring. Returning crop residue to the surface or the regular incorporation of other organic material into the plow layer maintains tilth and fertility, reduces crusting, and increases water intake.

This soil can be used for pasture or hay. Overgrazing causes compaction, results in poor tilth, and reduces production of desirable grasses. Proper stocking, pasture rotation, and timely deferment of grazing help keep the pasture and soil in good condition.

This soil is well suited to hardwood trees. Native trees are scattered in a few areas. Trees grow well if competing vegetation is controlled. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

This soil is in capability class I.

424D2—Lindley-Keswick loams, 9 to 14 percent slopes, moderately eroded. These strongly sloping, well drained to moderately well drained soils are on convex side slopes of dissected, glacial till uplands. The Lindley loam is on convex slopes and is below the Keswick loam. The Keswick loam is on convex shoulders and is on the upper part of the slope. Individual areas are made up of 60 percent Lindley soils and 30 percent Keswick soils. These areas are irregular in shape. They are usually long and narrow and follow the contour of the side slope. They range from 10 to 30 acres in size.

Typically the Lindley soil has a surface layer that is dark grayish brown and brown loam about 6 inches thick. The upper part of the subsoil is light brownish gray and yellowish brown, firm clay loam to a depth of 36 inches. The lower part of the subsoil and the substratum are mottled yellowish brown, firm clay loam to a depth of 60 inches.

Typically the Keswick soil has a surface layer of dark grayish brown and brown loam about 7 inches thick. The upper part of the subsoil is mottled brown and reddish brown, firm silty clay loam and clay loam to a depth of 24 inches. The lower part of the subsoil is yellowish brown and gray, firm clay loam to a depth of 60 inches. A pebble band is in the upper part of the subsoil.

Included with these soils in mapping are small remnants of loess on the narrow ridges. Also there are small areas of severely eroded soils. These areas are 1/2 to 1 acre in size. The eroded soils have a thinner and lighter colored surface layer. In the heads of drainageways are a few spots of Lamoni soils. The included soils total about 10 percent of this unit.

Permeability is moderately slow in the Lindley soil and slow in the Keswick soil. Organic matter in the surface layer is less than 1 percent. Available water capacity is high. Surface runoff is rapid. The Keswick soil has a seasonal high water table. Generally tilth is poor in both soils. Shrink-swell potential is moderate in the Lindley soil and high in the Keswick soil. Reaction in the surface layer is slightly acid or medium acid. Available phosphorus and available potassium are very low in the Keswick subsoil. Available phosphorus is medium and available potassium is very low in the Lindley subsoil. These soils commonly have seepy spots in wet seasons.

These soils are used for cultivated crops and pasture. A few areas are in woodland. The soils are moderately suited to grasses, legumes, and oats.

If these soils are used for corn or soybeans, erosion is a hazard. Row crops can be used in a crop rotation when grasses and legumes need reseeding. Conservation tillage on the contour helps reduce runoff and increase water intake. The return of crop residue to the surface and the addition of other organic material help to maintain tilth and increase water infiltration. Crop response is favorable with the addition of needed commercial fertilizer. Interceptor drains can be used to control seeps.

The use of these soils for pasture and hay is effective in controlling erosion. The steepness of the slope, compaction by farm machinery, or grazing under wet conditions accelerates runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods helps keep the pasture or hayland in good condition.

These soils are moderately well suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

These soils are in capability subclass IVe.

425D2—Keswick loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on shoulders of convex side slopes. Individual areas of this unit are narrow bands around the contour of the slope. They are about 200 to 300 feet wide. They range from 10 to 25 acres in size.

Typically the surface layer is very dark gray loam about 2 inches thick. The subsurface layer is dark grayish brown and brown loam about 7 inches thick. The upper part of the subsoil is brown, friable silty clay loam and reddish brown, mottled, firm clay loam to a depth of 24 inches. The lower part of the subsoil is mottled yellowish brown and gray, firm clay loam to a depth of 60 inches. A pebble band is in the upper part of the subsoil.

Included with this soil in mapping are small areas of Lindley soils that are on the lower part of the slopes. A mantle of loess is on some ridgetops. These included soils are less than 10 percent of the unit.

Permeability in this Keswick soil is slow. Organic matter in the surface layer is 1 to 3 percent. Available water capacity is high. Surface runoff is medium. This soil has a seasonal high water table. Generally tilth is poor. Shrink-swell potential is high. Reaction in the surface layer is medium or slightly acid. Available phosphorus and available potassium are very low in the subsoil. This soil commonly has seepy spots in wet seasons.

This soil is used for cultivated crops and pasture. A few areas are in woodland. The soil is poorly suited to grasses, legumes, and oats. If the soil is used for corn or soybeans, erosion is a hazard. Row crops can be grown in a crop rotation system when grasses and legumes need reseeding. Conservation tillage on the contour

reduces runoff and increases water intake. The return of crop residue to the surface and the incorporation of other organic material into the plow layer maintain tilth and increase water infiltration. Crop response is favorable with the addition of needed commercial fertilizer. Interceptor drains can be used to control seeps.

The use of this soil for pasture and hay is effective in controlling erosion. The steepness of slope, compaction by farm machinery, or grazing under wet conditions accelerates runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture of hayland in good condition.

This soil is moderately well suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

This soil is in capability subclass IVe.

428B—Ely silty clay loam, 2 to 5 percent slopes. This gently sloping, somewhat poorly drained soil is on slightly concave, low foot slopes and on alluvial fans. Ely soils formed in alluvium and colluvium and receive some water from seepage of adjoining, higher soils. Individual areas are irregular in shape; and they are in narrow bands. They range from 10 to 15 acres in size.

Typically the surface layer is very dark brown silty clay loam about 8 inches thick. The subsurface layer is black and very dark gray silty clay loam about 14 inches thick. The subsoil extends to a depth of 58 inches. To a depth of 30 inches, it is very dark grayish brown and very dark gray, friable silty clay loam. From 30 to 40 inches it is grayish brown and mottled silty clay loam. Below that, it is brown and grayish brown silty clay loam. The substratum is brown and grayish brown silty clay loam to a depth of about 60 inches.

Included with this soil in mapping are Colo and Judson soils. The poorly drained Colo soils have a black surface layer that is thicker than that of the Ely soils. Judson soils are moderately well drained or well drained and are also on alluvial fans and foot slopes. In some places stratified, recent overwash is on the surface. Inclusions make up less than 10 percent of this unit.

Permeability in this Ely soil is moderate, and surface runoff is medium. This soil has a seasonal high water table. Organic matter in the surface layer is about 5 to 6 percent. Available water capacity is high. Reaction in the surface layer is medium or slightly acid. Available phosphorus and available potassium are very low in the subsoil. The shrink-swell potential is moderate.

Most of this soil is in crops, but some areas are in pasture. This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Most individual areas are generally so small in size that this soil is cropped with adjacent soils. In some areas this soil is subject to seepage and runoff from side slopes. When it is used for cultivated crops, erosion is a hazard. Conservation tillage helps prevent soil loss. Diversion terraces protect this soil from the runoff of higher lying soils. Returning crop residue to the soil or the regular incorporation of other organic material into the plow layer improves fertility and maintains good tilth.

The use of the soil for pasture or hay is also effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is in capability unit IIe.

430—Ackmore silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained or poorly drained soil is on flood plains or alluvial fans. This soil is subject to flooding. Individual areas are irregular in shape or are long and moderately wide. They parallel the stream and are 10 to 80 acres in size.

Typically the surface layer is very dark grayish brown silt loam about 6 inches thick. The substratum is about 19 inches thick. It is stratified very dark gray and dark grayish brown, friable silt loam. The next layer is black or very dark gray, firm silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Colo and Zook soils that have concave slopes. These soils are wetter than the Ackmore soils. The Colo and Zook soils tend to be ponded after rains. Inclusions make up less than 10 percent of this unit.

Permeability in this Ackmore soil is moderate. This soil has a seasonal high water table. Runoff is slow. Organic matter in the surface layer is 2 to 4 percent. Available water capacity is high. Reaction in the solum is typically slightly acid or neutral. Available phosphorus is generally low and available potassium is very low in the subsoil. Tilth is good. The shrink-swell potential is moderate.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, small grain, and grasses and legumes for hay or pasture. Most areas are suited to growing row crops intensively if this soil is adequately protected from flooding. Most flooding occurs before row crops are planted. Levees and dikes provide flood protection. The proper placement of subsurface and surface drains allows for timely tillage and earlier seeding, especially during a wet spring. Returning crop residue to the surface or the regular incorporation of other organic material into the plow layer maintains tilth and fertility, reduces crusting, and increases water infiltration.

The soil can be used for pasture or hay. Overgrazing causes compaction, which results in poor tilth and reduces production of desirable grasses. Proper stocking, pasture rotation, and timely deferment of grazing help keep the pasture and soil in good condition.

This soil is well suited to trees. Tree seeds, seedlings, and cuttings survive and grow well if competing

vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, or girdling.

This soil is in capability subclass IIw.

442E2—Downs-Chelsea complex, 14 to 18 percent slopes, moderately eroded. These moderately steep, well drained and excessively drained soils are on convex sides of valleys. They are in the northeast part of the county. Individual areas are about 60 percent Downs silt loam and 30 percent Chelsea loamy fine sand. These soils are so intricately mixed that it is not practical to separate them in mapping. These areas are irregular in shape and range from 10 to 30 acres in size.

Typically the Downs soil has a surface layer of mixed brown and dark grayish brown silt loam about 6 inches thick. The subsoil is friable silty clay loam to a depth of about 60 inches. It is yellowish brown in the upper part. It has a few grayish brown mottles in the lower part. In places sand is under the Downs soil at a depth of 40 inches or more.

Typically the Chelsea soil has a surface layer that is dark grayish brown loamy fine sand about 6 inches thick. The next layer extends to a depth of 36 inches. It is brown loamy fine sand in the upper part and yellowish brown fine sand in the lower part. Below this is yellowish brown and brown, loose fine sand and narrow bands of brown sandy loam to a depth of 60 inches. In places the Chelsea soil is severely eroded.

Included in mapping this unit are small areas of Liscomb loam that is on the lower part of the slope. In some places the Downs and Chelsea soils have slopes of less than 14 percent. Inclusions make up less than 5 percent of this unit.

Permeability is moderate in the Downs soil and is rapid in the Chelsea soil. Surface runoff for both soils is rapid. Available water capacity is high in the Downs soil and low in the Chelsea soil. Organic matter content in the surface layer is 1 to 3 percent in the Downs soil and is less than 1 percent in the Chelsea soil. Reaction in the surface layer is neutral to medium acid. Available phosphorus is medium in the Downs subsoil and is very low in the Chelsea subsoil. Available potassium is very low in the subsoil. The shrink-swell potential is moderate in the Downs soil and low in the Chelsea soil.

Most areas are in pasture and hay. These soils are poorly suited to cultivated crops and moderately suited to hay, pasture, and trees. Generally these soils have low natural fertility, and in some areas they are difficult to vegetate.

The use of these soils for pasture is effective in controlling erosion. Overgrazing and grazing when the Downs soil is too wet cause surface compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during dry periods help keep pasture in good condition.

These soils are moderately suited to trees. A plant cover should be maintained to reduce erosion. Special equipment might be needed because of the steep slopes. The Chelsea soil is droughty, and extra water might be needed to reduce seedling mortality. Plant competition can be controlled by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

These soils are in capability subclass VIe.

451D2—Caleb loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on side slopes of high bench terraces that blend into side slopes of uplands. Individual areas are irregular and small. They seldom exceed 8 acres.

Typically the surface layer is mixed very dark grayish brown, grayish brown, and brown loam about 6 inches thick. The subsoil is brown, friable sandy clay loam to a depth of 26 inches. Below this it is yellowish brown, friable sandy clay loam and sandy loam to a depth of about 60 inches. The lower part of the solum is stratified. In some areas the surface layer is very dark grayish brown loam about 10 inches thick.

Included with this soil in mapping are a few areas of severely eroded soils and short, steep slopes. The severely eroded soils have a thinner and lighter colored surface layer. Inclusions make up less than 10 percent of this unit.

Permeability in this Caleb soil is moderate, and runoff is rapid. This soil has a seasonal high water table. Organic matter in the surface layer is 0.5 to 1.5 percent. Available water capacity is moderate. Reaction in the surface layer is slightly acid. Available phosphorus and available potassium are very low in the subsoil. The shrink-swell potential is moderate.

About 50 percent of this Caleb soil is in hay or pasture and 50 percent is in crops. This soil is poorly suited to corn and soybeans and is better suited to small grain, grasses, and legumes.

If the soil is used for cultivated crops, erosion is a hazard. Row crops can be used in a crop rotation when grasses and legumes need reseeding. Conservation tillage on the contour reduces runoff and increases water intake. The return of all crop residue to the surface and the incorporation of other organic material and commercial fertilizer into the plow layer maintain tilth and fertility.

The use of the soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is wet causes surface compaction, which causes excessive runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture and soil in good condition.

This soil is moderately well suited to hardwood trees; a few scattered trees are in some areas. Trees survive if competing vegetation is controlled. This can be accomplished by site preparation or by cutting, girdling, or spraying. Erosion is a hazard during site preparation.

This soil is in capability subclass IVe.

453—Tuskeego silt loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on bottom lands. It is in slightly depressional areas adjacent to the major streams of the county. This soil is subject to flooding. Individual areas are broad and irregular in shape. They range from 5 to 15 acres in size.

Typically the surface layer is very dark gray silt loam about 8 inches thick. The subsurface layer is mottled dark gray and gray silt loam about 9 inches thick. The subsoil is firm silty clay and silty clay loam to 60 inches. It is mottled very dark gray, dark gray, and gray in the upper part and gray in the lower part.

Included with this soil in mapping are soils that have a darker subsoil than the Tuskeego soil. A few small areas of Colo and Zook soils are included on the outer edges. Inclusions make up less than 10 percent of this unit.

Permeability in this Tuskeego soil is very slow. The soil is saturated with water during some seasons. Available water capacity is high. Organic matter in this soil is 2 to 3 percent. Available phosphorus and available potassium are generally very low in the subsoil. Reaction in the surface layer is neutral. This soil has a seasonal high water table, especially during wet seasons. Runoff is slow. The shrink-swell potential is high.

Most of the soil is cultivated, but some areas are used for hay or pasture. This soil is well suited to hay, but it needs drainage. If adequately drained, it is moderately suited to corn and soybeans. In small areas subsurface drains generally work; however, in large areas surface drains are needed because of the very slow permeability of the subsoil. In some places locating drainage outlets is difficult. The return of crop residue to the surface and the incorporation of other organic material into the plow layer improve fertility, reduce crusting, and increase water infiltration. This soil is generally farmed with the adjoining soils.

If this soil is used for pasture or hay, overgrazing causes deterioration of the water-tolerant plant community. Overgrazing when the soil is too wet causes compaction, which reduces water infiltration and results in poorer tilth. Perennial plants should have a fairly high tolerance for wetness. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods keep the pasture and soil in good condition. Soil erosion is not a major problem on this unit.

This soil is moderately suited to softwood trees that tolerate wetness. Special equipment might be needed to overcome the wet soil conditions. Seedling mortality is high, unless excess water is removed. Plant competition must be controlled by careful site preparation; or by cutting, spraying or girdling.

This soil is in capability subclass IIIw.

462B—Downs silt loam, benches, 2 to 5 percent slopes. This gently sloping, well drained soil is on benches adjacent to the major streams. Individual areas are irregular in shape. They range from 10 to 40 acres or more in size.

Typically the surface layer is very dark gray silt loam about 8 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 4 inches thick. The subsoil is friable silty clay loam to a depth of 60 inches. It is dark brown and brown to a depth of 33 inches. The lower part is brown and yellowish brown and a few grayish brown mottles. It is underlain by sand or fine gravel. In some places sand or fine gravel is at a depth of less than 60 inches.

Permeability in this Downs soil is moderate. Organic matter in the surface layer is 3 to 4 percent. Available water capacity is high. Surface runoff is medium. The shrink-swell potential is moderate. Unless the surface layer is limed, reaction is typically medium acid. Available phosphorus is medium and available potassium is very low in the subsoil. Tilth is good.

Most areas of this soil are cultivated. This soil is well suited to corn and soybeans if they are used in a crop rotation with small grains and hay. If row crops are grown often in the rotation, tilling on the contour, stripcropping, or terracing and conservation tillage are needed to help prevent soil loss. The return of crop residue to the surface and the incorporation of liberal amounts of other organic material into the plow layer maintain fertility and tilth.

This soil is well suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

This soil is in capability subclass IIe.

462C2—Downs silt loam, benches, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on benches and side slopes of benches adjacent to major streams. Individual areas are irregular in shape. They range from 10 to 20 acres in size.

Typically the surface layer is mixed very dark grayish brown and brown silt loam about 8 inches thick. The subsoil is brown and yellowish brown, friable silty clay loam to a depth of about 60 inches. It has some grayish brown mottles in the lower part. Below this is stratified sand and gravel. In some places the surface layer is darker colored.

Included with this soil in mapping are a few small areas of Fayette soils. The Fayette soils are in positions on the landscape similar to those of the Downs soil. Small areas of Colo, Ely, and Judson soils are in narrow drainageways. Inclusions make up less than 10 percent of this unit.

Permeability in this Downs soil is moderate. Organic matter in the surface layer is about 1 to 3 percent. The shrink-swell potential is moderate. Available water capacity is high. Surface runoff is medium. Unless the surface layer is limed, reaction is usually medium acid. Available phosphorus is medium and available potassium is very low in the subsoil.

Most areas of this soil are cultivated. This soil is suited to growing row crops in about one-half of a crop rotation.

In cultivated fields this soil needs to be tilled on the contour, stripcropped, or terraced to help control erosion. Conservation tillage increases water intake and also reduces the chances of erosion. Grassed waterways are needed to prevent the formation of gullies. In some places terrace drop inlets could be constructed. The return of all crop residue to the surface and the addition of liberal amounts of other organic material maintain fertility and tilth.

This soil is well suited to trees. A few small areas are in native hardwoods. Tree seeds, cuttings, and seedlings survive if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

This soil is in capability subclass IIIe.

484—Lawson silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on bottom lands. This soil is subject to flooding. Individual areas of this unit are broad and irregular. They range from 10 to 25 acres in size.

Typically the surface layer is very dark brown silt loam about 8 inches thick. The subsurface layer is black silt loam about 22 inches thick. The substratum grades from very dark gray silt loam to very dark grayish brown and dark grayish brown silty clay loam to a depth of 60 inches.

Included with this soil in mapping are Ackmore, Colo, and Zook soils. These soils are also on bottom land. Ackmore soils have recent stratification to a depth of 20 to 36 inches. In Colo soils, the solum is 36 to 54 inches thick and the clay content is 27 to 35 percent. In Zook soils, the solum is more than 40 inches thick and the clay content is between 32 and 42 percent. These included soils are less than 15 percent of the unit.

Permeability in this Lawson soil is moderate. Organic matter in the surface layer is 4 to 5 percent. Available water capacity is high. Surface runoff is slow. This soil has a seasonal high water table. Tilth is good. Shrink-swell potential is generally moderate. Reaction is neutral. Available phosphorus is low and available potassium is very low in the subsoil.

This soil is used for corn, soybeans and alfalfa. This soil is well suited to crops in spite of a hazard of flooding and a seasonal high water table. The proper placement of dikes, surface drains, and subsurface drains would benefit many of these areas. The use of minimum tillage increases water intake. The return of crop residue to the soil and the addition of other organic material maintain tilth and increase water infiltration. Crop response is favorable with the addition of needed commercial fertilizer.

This soil is moderately suited to trees. It has a seasonal high water table and is subject to flooding.

This soil is in capability subclass IIw.

488C2—Downs Variant silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is partly on short, convex to plane side slopes of nearly level, stable divides. This soil, however, is more commonly at the heads of drainageways. Individual areas are narrow and irregular in shape. They are in bands on the upper parts of the side slopes. They range from 5 to 20 acres in size.

Typically the surface layer is mixed very dark gray and dark grayish brown silt loam about 6 inches thick. The subsoil is about 54 inches thick. The upper part is brown, friable silty clay loam. The middle part is mottled dark yellowish brown, light brownish gray, and pale brown silty clay loam that is friable. The lower part is mottled light yellowish brown, light olive brown, light brownish gray, and grayish brown silt loam that is friable.

Included with this soil in mapping are small areas of Downs and Tama soils. The well drained Downs and Tama soils are in uplands. They are on convex ridgetops and convex side slopes. They are in similar positions on the landscape to the Downs Variant. Also included are soils that have a surface layer that is 10 inches or more thick. They are located at the base of upland slopes and in drainageways that are too narrow to be mapped separately. Inclusions make up less than 10 percent of this unit.

Permeability in this Down Variant is moderate. Runoff is medium, and soil erosion is a hazard. Organic matter in the surface layer is 1 to 3 percent. Available water capacity is high. Unless the surface layer is limed, reaction is medium acid. Available phosphorus is medium and available potassium is very low in the subsoil. The shrink-swell is moderate. Tilth is fair to good.

The soil is used for corn, soybeans, hay, pasture, and trees. It is suited to corn and soybeans.

In cultivated fields this soil needs to be tilled on the contour, stripcropped, or terraced to help control erosion. Conservation tillage on the contour increases water intake, and terraces control runoff of excess water. Grassed waterways are needed to prevent formation of gullies, and in some places terrace drop inlets could be constructed. The return of crop residue to the surface and the incorporation of other organic material into the plow layer maintain tilth. Crop response is favorable with the addition of needed commercial fertilizer.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees, and a few small areas are in native hardwoods. Tree seeds, cuttings, and seedlings survive if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, or girdling.

This soil is in capability subclass IIIe.

488D2—Downs Variant silt loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is partly on short, convex to plane side slopes of nearly level, stable divides. This soil, however, is more commonly at the heads of drainageways. Individual areas are narrow and irregular in shape. They are in bands on the upper parts of side slopes. They range from 5 to 25 acres in size.

Typically the surface layer is mixed very dark gray and dark grayish brown silt loam about 6 inches thick. The subsurface layer and the upper part of the subsoil are usually mixed into the surface layer. The subsoil is about 54 inches thick. The upper part is brown and dark brown, friable silty clay loam. The middle part is friable silt loam that is mottled with dark yellowish brown and light brownish gray. The lower part increases in gray with depth.

Included with this soil in mapping are small areas of Downs and Tama soils. The well drained Downs and Tama soils are in the uplands. They are on convex ridgetops and convex side slopes. They are in similar positions on the landscape to the Downs Variant. Also included are soils that have a surface layer that is 10 inches or more thick. These soils are at the base of upland slopes and in narrow drainageways. Inclusions make up less than 10 percent of this unit.

Permeability in this Downs Variant soil is moderate. Runoff is medium, and the hazard of continued soil erosion is severe. Organic matter in the surface layer is 1 to 3 percent. Available water capacity is high. Unless the surface layer is limed, reaction is medium acid. Available phosphorus is medium and available potassium is very low in the subsoil. Shrink-swell potential is moderate. Tilth is fair to good.

The soil is used for crops, hay, pasture, and trees. It is moderately suited to grasses, legumes, corn, soybeans, oats, and trees.

When the soil is used for cultivated crops, erosion is a hazard. Conservation tillage on the contour increases water intake. Terraces and contour stripcropping help to control erosion and excess runoff of water. Terraces are difficult to establish on these slopes. Grassed waterways are needed to prevent formation of gullies, and in some places terrace drop inlets could be constructed. The return of crop residue to the surface and the addition of other organic material help to maintain tilth. Crop response is favorable with the addition of needed commercial fertilizer. A cropping sequence should include oats and a mixture of alfalfa and brome.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees, and a few small areas are in native hardwoods. Tree seeds, cuttings, and seedlings survive if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, or girdling.

This soil is in capability subclass IIIe.

570C2—Nira silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on short, convex side slopes at the heads of drainageways. These drainageways are near stable divides. This soil is in uplands. Individual areas are irregular in shape and range from 5 to 20 acres in size.

Typically the surface layer is very dark gray and very dark grayish brown silty clay loam about 7 inches thick. The subsoil is 37 inches thick. It is brown friable silty clay loam that has dark brown ped coatings. This grades into a mottled olive gray and light olive gray, friable silty clay loam. The substratum is light olive gray, friable silty clay loam with common, prominent, yellowish red mottles to a depth of 60 inches. In some places the surface layer is brown silty clay loam about 6 inches thick.

Permeability in this Nira soil is moderate. Organic matter in the surface layer is 2 to 3 percent. Surface runoff is medium. The shrink-swell potential is moderate. Available water capacity is high. Reaction in the surface layer is neutral. Available phosphorus and available potassium are very low.

This soil is mostly cultivated and is used intensively for corn and soybeans. This soil is suited to corn and soybeans if it is used in a cropping sequence with oats and hay.

When row crops are grown, tilling on the contour, stripcropping, or terracing and conservation tillage are needed to help prevent soil loss. Conservation tillage increases water intake and also reduces the chance of erosion. Eroded soils are low in organic matter. Crop residue should be returned to the soil or other organic material added to the plow layer. Grassed waterways and terrace drop inlets could be constructed.

This soil is in capability subclass IIIe.

570D2—Nira silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on short, convex side slopes that border the heads of drainageways. These drainageway are near stable divides. This soil is in uplands. Individual areas are irregular in shape. They range from 5 to 20 acres in size.

Typically the surface layer is mixed very dark gray and brown silty clay loam about 6 inches thick. The subsoil is 34 inches thick. It is brown, friable silty clay loam with dark brown ped coatings in the upper part. This grades to mottled olive gray, friable silty clay loam in the lower part. The substratum is light olive gray, silty clay loam to a depth of 60 inches. It has common, prominent, yellowish red mottles. In some places the surface layer is brown silty clay loam about 6 inches thick.

Permeability in this Nira soil is moderate. Organic matter in the surface layer is 1 to 3 percent. Surface

runoff is medium. The shrink-swell potential is moderate. Available water capacity is high. Reaction in the surface layer is neutral. Available phosphorus and available potassium are very low in the subsoil.

This soil is mostly cultivated and used intensively for row crops. It is suited to corn and soybeans if they are used in a cropping sequence with oats and hay.

In cultivated fields the soil needs to be tilled on the contour, stripcropped, or terraced to help control erosion. Terracing is difficult on these slopes. Row crops can be included in the cropping system fairly often if the soils are terraced and tilled on the contour. Grassed waterways are needed to prevent formation of gullies, and in many places terrace drop inlets could be constructed. Conservation tillage increases water intake and also reduces the hazard of erosion. The return of crop residue to the surface and the addition of liberal amounts of other organic material maintain fertility and tilth.

This soil is in capability subclass IIIe.

571C2—Hedrick silty clay loam, 5 to 9 percent slopes, moderately eroded. Some of this moderately sloping, moderately well drained soil is on short, convex to plane side slopes of nearly level, stable divides. This soil, however, is more commonly at the heads of drainageways. It is in uplands. Individual areas are narrow and irregular in shape. They are in bands on the upper parts of the side slopes. They range from 5 to 20 acres in size.

Typically the surface layer is very dark grayish brown and dark grayish brown silty clay loam about 7 inches thick. The subsoil is friable silty clay loam to a depth of 60 inches. It is brown and dark yellowish brown in the upper part. The lower part is mottled brown, strong brown, and grayish brown and becomes more gray with depth.

Included with this soil in mapping are small areas of Clinton and Ladoga soils. The moderately well drained Clinton and Ladoga soils are in uplands. They are on convex ridgetops and convex side slopes in similar positions to the Hedrick soils. Also included are soils that have a surface layer more than 10 inches thick. They are located at the base of upland slopes and in drainageways that are too narrow to be mapped separately. Inclusions make up less than 10 percent of this unit.

Permeability in this Hedrick soil is moderate. Runoff is medium. Organic matter in the surface layer is 1 to 3 percent. Available water capacity is high. Reaction in the surface layer is slightly acid. Available phosphorus is medium and available potassium is very low in the subsoil. The shrink-swell potential is moderate. Tilth is fair to good.

The soil is used for corn, soybeans, hay, pasture, and trees. This soil is suited to corn and soybeans. These crops are grown in rotation with oats and hay.

In cultivated fields this soil needs to be tilled on the contour, stripcropped, or terraced to help control erosion. Conservation tillage on the contour increases water intake, and terraces control runoff of excess water. The return of crop residue to the surface and the addition of other organic material help to maintain tilth. Crop response is favorable with the addition of needed commercial fertilizer.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees, and a few small areas are in native hardwoods. Tree seeds, cuttings, and seedlings survive if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, or girdling.

This soil is in capability subclass IIIe.

571D2—Hedrick silty clay loam, 9 to 14 percent slopes, moderately eroded. Some of this strongly sloping, moderately well drained soil is on short, convex to plane side slopes of nearly level, stable divides. This soil, however, is more commonly at the heads of drainageways. It is in uplands. Individual areas are narrow and irregular in shape. They are in bands on the upper parts of side slopes. They range from 5 to 25 acres in size.

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

Included with this soil in mapping are small areas of Clinton and Ladoga soils. The moderately well drained Clinton and Ladoga soils are in uplands. They are on convex ridgetops and convex side slopes in similar positions to the Hedrick soil. Also included are soils that have a surface layer 10 inches or more thick. These soils are at the base of upland slopes and in drainageways that are too narrow to be mapped separately. Inclusions make up less than 10 percent of this unit.

Permeability in this Hedrick soil is moderate. Runoff is rapid. Organic matter in the surface layer is 1 to 3 percent. Available water capacity is high. Reaction in the surface layer is slightly acid. Available phosphorus is medium and available potassium is very low in the subsoil. The shrink-swell potential is moderate. Tilth is fair to good.

The soil is used for corn, soybeans, hay, pasture, and trees. It is suited to corn, soybeans, grasses, legumes, oats, and trees.

When the soil is used for cultivated crops, erosion is a hazard. Conservation tillage on the contour increases

water intake. Terraces and contour stripcropping help control erosion and excess runoff of water. Terraces are difficult to construct on these slopes. Grassed waterways are needed to prevent formation of gullies, and in some places terrace drop inlets could be constructed. The return of crop residue to the surface and the incorporation of other organic material into the plow layer help to maintain tilth. Crop response is favorable with the addition of needed commercial fertilizer. A cropping sequence should include oats and a mixture of alfalfa and brome.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees, and a few small areas are in hardwoods. Tree seeds, cuttings, and seedlings survive if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, or girdling.

This soil is in capability subclass IIIe.

592D2—Mystic clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained or somewhat poorly drained soil is on extended nose slopes of hills adjacent to stream valleys, or it is on old foot slopes of river valleys. Individual areas are irregular in shape and 5 to 20 acres in size.

Typically the surface layer is very dark grayish brown and brown clay loam about 6 inches thick. The subsoil is 45 inches thick. The upper part is dark brown and brown, firm clay loam and clay. The middle part grades into dark grayish brown, grayish brown, and brown clay and clay loam that is firm. The lower part is grayish brown and light brownish gray, friable loam. The substratum is light brownish gray to a depth of about 60 inches. In places the surface layer is brown clay loam about 5 inches thick.

Included with this soil in mapping are small areas of sandy soils on the lower parts of side slopes. Inclusions make up less than 5 percent of this unit.

Permeability in this Mystic soil is slow. Organic matter in the surface soil is 1 to 3 percent. Surface runoff is medium to rapid. This soil has a seasonal high water table. The water table fluctuates from a depth of 3 to 5 feet. This fluctuation depends on rainfall. The shrink-swell potential is moderate. Available water capacity is high. Unless the surface soil is limed, reaction is medium acid. Available phosphorus and available potassium are very low in the subsoil. Tilth is poor.

Most areas of this soil are in pasture. This soil is best used for oats, hay, and pasture. This is effective in controlling erosion. Corn and soybeans can be used in a cropping sequence with oats, hay, and pasture when conservation measures are used to control erosion. Stripcropping that leaves one-half of the the area in meadow helps control erosion and reduce runoff of water. Conservation tillage on the contour also reduces runoff and increases water intake. Returning all crop residue to the surface and the addition of other organic material help to maintain tilth and fertility. Interceptor drains can be used to control seeps. Terraces are very difficult to construct on this soil.

This soil is moderately well suited to trees. It has a seasonal high water table. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

This soil is in capability subclass IVe.

683D2—Liscomb loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on the lower parts of convex side slopes. This soil is in uplands and is in the northeast part of the county. Individual areas are irregular in shape and range from 10 to 30 acres in size.

Typically the surface layer is a mixture of very dark grayish brown and brown loam about 8 inches thick. The subsoil is 38 inches thick. It is brown, friable loam in the upper part and dark yellowish brown, friable sandy clay loam and sandy loam in the lower part. The substratum is a yellowish brown sandy clay loam to a depth of about 60 inches. In places the surface layer is thicker and darker colored.

Included with this soil in mapping are small areas of Dinsdale and Tama soils. These soils are on narrow ridges that are mantled by loess. Inclusions make up less than 5 percent of this unit.

Permeability in this Liscomb soil is moderate. Runoff is rapid, and the hazard of erosion is severe. Reaction in the surface layer is 1 to 3 percent. The shrink-swell potential is low. Available water capacity is high. Reaction in the surface layer is neutral or slightly acid. Available phosphorus is very low and available potassium is low in the subsoil. Tilth is good.

This soil is used for row crops, meadow, and pasture. It is suited to grasses, legumes, and oats.

If the soil is used for cultivated crops, erosion is a hazard. If the soil is terraced, row crops can be grown part of the time. Terraces help control runoff of excess water. Conservation tillage on the contour increases water intake. The return of crop residue to the surface and the incorporation of other organic material into the plow layer help to maintain tilth. Crop response is favorable with the addition of needed commercial fertilizer.

The use of this soil for pasture or hay is also effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is in capability subclass IIIe.

687—Watkins silt loam, 0 to 2 percent slopes. This nearly level, well drained and moderately well drained soil is on low benches along streams or on high second bottom lands. This soil is normally above flood levels; however, it is subject to rare flooding. Individual areas are irregular in shape and generally range from 5 to 20 acres in size.

Typically the surface layer is very dark gray silt loam about 7 inches thick. The subsurface layer is very dark grayish brown and brown silt loam about 5 inches thick. The subsoil is about 44 inches thick. The upper part is brown and dark yellowish brown, firm silty clay loam; the lower part is dark yellowish brown, firm silty clay loam. The substratum is brown, firm silty clay loam to a depth of about 60 inches. In some places the subsurface layer is absent.

Included with this soil in mapping are small areas of soils that are somewhat poorly drained or poorly drained. They are in depressions or swales. Inclusions make up less than 10 percent of this soil.

Permeability in this Watkins soil is moderate. Organic matter in the surface layer is 2 to 3 percent. Shrink-swell potential is moderate. Available water capacity is high. Surface runoff is medium. Reaction in the surface layer is slightly acid. Available phosphorus is low and available potassium is very low in the subsoil. Tilth is good.

Most areas of this soil are used for corn, soybeans, and small grains; some areas are in woodland and pasture. This soil is well suited to corn, soybeans, oats, and hay.

Generally these areas are cropped with adjacent soils. Surface or subsurface drains are not normally needed for this soil. They can be beneficial, however, in the areas of included soils that are in the depressions and swales. In some places diversions are beneficial in preventing runoff from adjacent side slopes. The return of crop residue to the surface and the addition of liberal amounts of other organic material maintain soil fertility and tilth.

This soil is suited to hay and pasture in a cropping sequence. Brome and alfalfa are the main grasses and legumes used in the rotation. The use of grasses and legumes improves water intake, protects the soil from wind erosion, and improves tilth. Overgrazing or grazing when the soil is too wet causes compaction and results in poor tilth. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees. Scattered native trees are in a few areas. Tree seedlings and cuttings survive and grow well if competing vegetation is controlled. Proper site preparation is essential for growth of the trees.

This soil is in capability class I.

688—Koszta silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on benches or high second bottoms along streams. This soil floods during some years. Individual areas are in a broad, irregular pattern. They generally range from 5 to 30 acres.

Typically the surface layer is very dark brown silt loam about 10 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 5 inches thick. The subsoil is mottled dark grayish brown, gray, and yellowish brown, friable silty clay loam to a depth of 52 inches. The substratum is mottled gray and yellowish brown silty clay loam to a depth of about 60 inches.

Permeability in this Koszta soil is moderate. This soil has a seasonal high water table, and runoff is slow. Organic matter in the surface layer is 1 to 2 percent. The shrink-swell potential is moderate. Reaction in the surface layer is neutral. Available phosphorus is low and available potassium is very low in the subsoil. Available water capacity is high.

Most areas of this soil are cultivated. This soil is well suited to corn, soybeans, small grains, grasses and legumes for hay and pasture, and trees.

Small areas are cropped with adjacent soils. This soil is slightly higher in elevation than the adjacent first bottom lands and is rarely flooded. Areas adjacent to foot slopes may receive runoff. Subsurface drains are not normally needed, but they can be beneficial in some areas. Diversions prevent runoff from adjacent side slopes. The return of crop residue to the surface and the incorporation of liberal amounts of other organic material into the plow layer maintain fertility and tilth.

This soil is suited to hay and pasture in a cropping sequence. Hay is used more often than pasture. Alfalfa is the main plant grown. Both warm and cool season grasses should be included in a pasture rotation system to obtain the maximum benefit. Grasses and legumes increase water intake, protect the soil from wind erosion, and improve tilth. Overgrazing or grazing when the soil is too wet causes compaction, which results in poor tilth. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees. Special equipment might be needed because of the wetness of the soil. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

This soil is in capability class I.

792D2—Armstrong loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained or somewhat poorly drained soil is on shoulders of convex side slopes. These soils are in glaciated uplands. Individual areas of this unit are narrow bands 200 to 300 feet wide. Individual areas range from 10 to 25 acres in size.

Typically the surface layer is very dark grayish brown and grayish brown loam about 7 inches thick. The

subsoil is about 53 inches thick. The upper part is dark yellowish brown and brown, friable clay loam and loam. The middle part is mottled brown, strong brown, and grayish brown clay loam that has red mottles and is firm. The lower part is yellowish brown, firm clay loam. A band of pebbles is in the upper part of the subsoil.

Included with this soil in mapping are small areas of Gara soils that are downslope from the Armstrong soil. A mantle of loess is on some ridgetops. These included soils are usually less than 10 percent of the unit.

Permeability in this Armstrong soil is slow. Organic matter in the surface layer is 1 to 3 percent. Available water capacity is high. Surface runoff from cultivated soils is medium. This soil has a seasonal high water table. The shrink-swell potential is high. Reaction in the surface layer is neutral to medium acid. Available phosphorus and available potassium are very low in the subsoil. Generally tilth is poor. During the spring and wet cycles, seeps are common.

This soil is used for corn, soybeans, pasture, and trees. It is suited to grasses, legumes, and oats.

If the soil is used for cultivated crops, erosion is a hazard. In a cropping sequence, row crops are alternated with grasses and legumes. Conservation tillage on the contour reduces runoff and increases water intake. Terraces are very difficult to construct and maintain on this soil. The return of crop residue to the surface and the incorporation of liberal amounts of other organic material into the plow layer maintain tilth. Crop response is favorable with the addition of needed commercial fertilizer. Interceptor drains can be used to control seeps.

The use of this soil for hay or pasture is effective in controlling erosion. Slope, compaction by farming implements, or grazing under wet conditions are problems with this soil. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture or hayland in good condition.

This soil is moderately well suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

This soil is in capability subclass IVe.

822D2—Lamoni silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, somewhat poorly drained soil is on shoulders of slopes and in coves of the upper reaches of drainageways. Individual areas of this unit are in narrow bands. They are 5 to 20 acres in size.

Typically the surface layer is mixed black and grayish brown silty clay loam about 7 inches thick. The subsoil is firm clay to a depth of 55 inches. The subsoil is mottled dark grayish brown, yellowish brown, and grayish brown in the upper part and mottled yellowish brown in the lower part. The substratum is mottled yellowish brown and strong brown clay loam to a depth of about 60 inches.

Included with this soil in mapping are small areas of Colo and Ely soils in narrow drainageways. Small areas of severely eroded Lamoni soils are also included. The severely eroded soils have a grayish brown silty clay loam surface layer. Inclusions make up less than 10 percent of this unit.

Permeability in this Lamoni soil is slow or very slow. Organic matter in the surface layer is 1 to 3 percent. Surface runoff is medium to rapid. This soil has a seasonal high water table. Available water capacity is high. Seeps are located where the loess and till come in contact. Reaction in the surface layer is slightly acid. Available phosphorus is low and available potassium is medium in the subsoil. Tilth is poor. The shrink-swell potential is high.

Most areas of this soil are cultivated. The use of this soil for oats, hay, and pasture is effective in controlling erosion. Row crops can be used when hay and pasture need reseeding. Stripcropping helps control erosion and reduces rapid runoff. Conservation tillage on the contour also reduces runoff and increases water intake. Terraces are difficult to construct on these soils. Returning crop residue to the surface and the incorporation of liberal amounts of other organic material into the plow layer maintain tilth and fertility. Interceptor drains can be used in seepy and wet soils. Grassed waterways might need subsurface drains before they are shaped and seeded to permanent vegetation.

This soil is in capability group IVe.

822E2—Lamoni silty clay loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, somewhat poorly drained soil is within coves near the upper reaches of drainageways. Individual areas of this unit are irregular in shape. They range from 5 to 25 acres in size.

Typically the surface layer is black silty clay loam about 10 inches thick. The subsoil is 40 inches thick. It is dark grayish brown, brown, and grayish brown, mottled, firm clay in the upper part and yellowish brown, mottled, firm clay loam in the lower part. The substratum is yellowish brown and strong brown, mottled clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Colo and Ely soils in narrow drainageways. Small areas of severely eroded Lamoni soils are also included. The severely eroded soils have a grayish brown silty clay loam surface layer. Inclusions make up less than 10 percent of this unit.

Permeability in this Lamoni soil is slow or very slow. Organic matter in the surface soil is 1 to 2 percent. Seeps occur where the loess and the till come in contact. Available water holding capacity is high, and surface runoff is rapid. This soil has a seasonal high water table. Reaction in the surface layer is slightly acid. Available phosphorus is low and available potassium is

medium in the subsoil. The soil has poor tilth, especially where it is severely eroded. Shrink-swell potential is high.

This soil is used for permanent pasture or hay, which is effective in controlling erosion. In some places these soils are in narrow bands within larger areas of more productive soils. These areas provide good habitat for wildlife. If grazing is permitted when the soil is wet, livestock cause puddling, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is in capability group VIe.

876B—Ladoga silt loam, benches, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on benches adjacent to major streams. Individual areas are irregular and broad in shape. They range from 10 to 30 acres in size.

Typically the surface layer is very dark gray silt loam about 7 inches thick. The subsurface layer is dark grayish brown and grayish brown silt loam about 3 inches thick. The subsoil is brown, friable silty clay loam to a depth of about 50 inches. The substratum is grayish brown and brown silty clay loam to a depth of 60 inches. Below this are strata of sand and gravel.

Included with this soil in mapping are soils that have a high sand content in the lower part of the subsoil. These soils are on slightly lower parts of the the side slopes of the benches. A few small areas of Judson soils are at the base of the upland side slopes that adjoin the benches. Inclusions make up less than 10 percent of this unit.

Permeability in this Ladoga soil is moderately slow. Surface runoff is medium. Available water capacity is high. Organic matter in the surface layer is 2 to 3 percent. The shrink-swell potential is moderate. Unless the surface soil is limed, reaction is medium acid. Available phosphorus is medium and available potassium is very low in the subsoil. Tilth is good.

This soil is used for corn, soybeans, oats, hay, and pasture. It is well suited to corn, soybeans, oats, hay, pasture, and woodland.

If the soil is used for cultivated crops, erosion is a hazard. Conservation tillage on the contour increases water intake. Terraces help control runoff of excess water. The return of crop residue to the surface and the incorporation of liberal amounts of other organic material into the plow layer maintain tilth. Crop response is favorable with the addition of needed commercial fertilizer.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

This soil is in capability subclass IIe.

876C2—Ladoga silt loam, benches, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on benches adjacent to the major streams. Individual areas are irregular and broad in shape. They are 10 to 20 acres in size.

Typically the surface layer is very dark gray, grayish brown, and brown silt loam about 6 inches thick. The subsoil is brown, friable silty clay loam to a depth of about 46 inches. The substratum is grayish brown and brown silty clay loam to a depth of 60 inches. Below this are strata of sand and gravel.

Included with this soil in mapping are soils that have a higher sand content. They are on the lower part of the side slope. A few small areas of Judson soils are at the base of the upland side slopes and on the upper parts of the benches. Inclusions make up less than 10 percent of this unit.

Permeability in this Ladoga soil is moderately slow. Available water capacity is high. Surface runoff is medium. Organic matter in the surface layer is 1 to 3 percent. The shrink-swell potential is moderate. Unless the surface soil is limed, reaction is medium acid. Available phosphorus is medium and available potassium is very low in the subsoil. Tilth is good.

This soil is used for corn, soybeans, small grains, meadow, and pasture. It is suited to grasses, legumes, oats, and trees.

If the soil is used for cultivated crops, erosion is a hazard. The eroded soils generally have lower yields than uneroded soils. Conservation tillage on the contour increases water intake. Terraces help control runoff of excess water. The return of crop residue to the soil and the addition of liberal amounts of other organic material help to maintain tilth. Crop response is favorable with the addition of needed commercial fertilizer. A cropping sequence should include oats and a mixture of alfalfa and brome.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees, and a few small areas are in native hardwoods. Tree seeds, cuttings, and seedlings survive if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, or girdling.

This soil is in capability subclass IIIe.

881B—Otley silty clay loam, benches, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on terraces or high benches along

streams. This soil is above flood plains. Individual areas are broad and irregular in shape. They range from 10 to 30 acres in size.

Typically the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is black and very dark grayish brown silty clay loam about 10 inches thick. The subsoil is friable silty clay loam to a depth of about 60 inches. It is brown in the upper part and yellowish brown and grayish brown in the lower part. It is underlain by stratified sand, silt, and gravel.

Included with this soil in mapping are small areas where sandy materials are at the surface. A few small areas of Mahaska soils are on the narrow, nearly level benches. Inclusions make up less than 10 percent of this unit.

Permeability in this Otley soil is moderate. Organic matter in the surface layer is 3 to 4 percent. Available water capacity is high. Surface runoff is medium. The shrink-swell potential is moderate. Reaction in the surface layer is usually neutral. Available phosphorus is low and available potassium is very low in the subsoil. Tilth is good.

This soil is mostly cultivated and used intensively for row crops. It is suited to corn and soybeans, but erosion is a hazard. A cropping sequence should include oats and a mixture of alfalfa and brome. Where row crops are grown often in the rotation, conservation tillage, tilling on the contour, and stripcropping or terracing help prevent soil loss. Return of crop residue to the surface maintains tilth. Crop response is favorable with adequate fertilization. This soil responds well to a high level of management.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is in capability subclass IIe.

881C2—Otley silty clay loam, benches, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on side slopes of terraces and high benches along streams. This soil is above the flood plains. Individual areas are broad and irregular, and in some places they are long and narrow on side slopes. They range from 10 to 20 acres in size.

Typically the surface layer is about 7 inches thick. It is mixed black and dark grayish brown silty clay loam. The subsoil is friable silty clay loam to a depth of 60 inches. It grades from brown to yellowish brown, then to grayish brown. It is underlain by stratified sand, silt, and gravel.

Permeability in this Otley soil is moderate. Organic matter in the surface layer is 2 to 3 percent. Available water capacity is high. Surface runoff is medium. Shrink-swell potential is moderate. Reaction in the surface layer is neutral. Available phosphorus is low and available potassium is very low in the subsoil. Tilth is good.

This soil is mostly cultivated and is used intensively for row crops. It is suited to corn and soybeans. Erosion is a hazard. Oats and a mixture of alfalfa and brome should be included in a cropping sequence. When row crops are grown in the rotation, conservation tillage increases water intake, and tilling on the contour, stripcropping, and terracing prevent soil loss. Return of crop residue to the surface maintains tilth. Crop response is favorable with adequate fertilization. This soil responds well to a high level of management.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is in capability subclass IIIe.

993D2—Gara-Armstrong loams, 9 to 14 percent slopes, moderately eroded. These strongly sloping, well drained to somewhat poorly drained soils are on convex side slopes that are dissected by drainageways. These soils are on the glaciated uplands and are in the upper reaches of the drainage system. The Gara soils are on the lower parts of side slopes adjacent to drainageways. Armstrong soils are in narrow bands on the shoulders of strongly sloping, convex side slopes. They are between the loess-covered ridgetop and the glacial till soils downslope. Individual areas are usually long and narrow and follow the contour of the side slope. Generally Armstrong soils make up 40 percent of the area and Gara soils make up 50 percent. The two soils are so intricately mixed on the landscape or so small in area that it is not practical to separate them in mapping. Individual areas range from 10 to 30 acres in size.

Typically the Gara soil has a surface layer of mixed dark grayish brown and yellowish brown loam about 6 inches thick. The subsoil is yellowish brown firm clay loam to a depth of about 40 inches. The substratum is yellowish brown and grayish brown, mottled clay loam to a depth of about 60 inches.

The Armstrong soil has a surface layer of mixed dark grayish brown and brown loam about 6 inches thick. The subsoil is brown, reddish brown, and strong brown, mottled, firm clay loam to a depth of 37 inches. Under this is yellowish brown and light brownish gray, firm clay loam to a depth of about 60 inches.

Included with these soils in mapping are small areas of slightly eroded and severely eroded soils that make up less than 5 acres. The slightly eroded soils have a darker surface layer more than 7 inches thick. The severely eroded soils have a lighter colored surface layer less than 6 inches thick. Seeps usually occur where the loess and the glacial till of the Armstrong soils come into contact. They are common in the heads of drainageways. Inclusions make up less than 10 percent of this unit.

Permeability is moderately slow in the Gara soil and slow in the Armstrong soil. Surface runoff is medium. The Armstrong soil has a seasonal high water table. Available water capacity is high. The shrink-swell potential is high in the Armstrong soil and moderate in the Gara soil. Unless the surface layer is limed, reaction is neutral to medium acid. Organic matter in the surface layer is 1 to 3 percent. Available phosphorus is very low to low and available potassium is very low in the subsoil. Tilth is poor in the Armstrong soil and good in the Gara soil.

Most areas of these soils are in pasture or woodland. These soils are best suited to grasses, legumes, and oats. Trees adapted to these soils can be grown.

If these soils are used for cultivated crops, erosion is a hazard. In a cropping sequence, row crops can be used when grasses and legumes need reseeding. Conservation tillage on the contour reduces runoff and increases water intake. Terraces are difficult to construct on these soils. The return of crop residue to the surface and the incorporation of liberal amounts of other organic material into the plow layer maintain tilth. Crop response is favorable with the addition of needed commercial fertilizer. Interceptor drains can be used in seepy and wet areas.

The use of this unit for pasture or hay is also effective in controlling erosion. Overgrazing and grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

These soils are moderately well suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, and girdling.

These soils are in capability subclass IVe.

993E2—Gara-Armstrong loams, 14 to 18 percent slopes, moderately eroded. These moderately steep, well drained to somewhat poorly drained soils are on convex side slopes. These soils are on dissected, glaciated uplands and are in the upper reaches of the drainage system. The Gara soils are downslope from the Armstrong soils, which are on the shoulders and upper part of the side slope. Individual areas are usually long and narrow and follow the contour of the side slope. The Gara soils make up 65 percent of the area, and the Armstrong soils make up 30 percent or more. These two soils are in such a complicated pattern on the landscape that it is not practical to separate them in mapping. Typical areas range from 5 to 25 acres in size.

Typically the Gara soil has a surface layer that is mixed dark grayish brown and yellowish brown loam about 6 inches thick. The subsoil is yellowish brown, firm clay loam to a depth of about 40 inches. The substratum is yellowish brown and grayish brown, mottled clay loam to a depth of 60 inches.

The Armstrong soil has a surface layer that is mixed dark grayish brown and brown loam 6 inches thick. The subsoil is brown, reddish brown, and strong brown clay loam that is mottled and firm to a depth of about 37 inches. Below this is yellowish brown and light brownish gray, firm clay loam to a depth of about 60 inches.

Included with these soils in mapping are areas of slightly eroded and severely eroded soils that make up less than 5 acres. The slightly eroded soils have a darker surface layer more than 7 inches thick. The severely eroded soils have a surface layer less than 6 inches thick. Seeps usually occur where the loess and the glacial till of the Armstrong soils come in contact. They are common in the heads of drainageways. Inclusions make up less than 10 percent of this unit.

Permeability is moderately slow in the Gara soil and slow in the Armstrong soil. Organic matter in the surface layer is 1 to 3 percent. Available water capacity is high. Surface runoff is rapid. The Armstrong soil has a seasonal high water table. The shrink-swell potential is high in the Armstrong soil and moderate in the Gara soil. Unless the surface layer is limed, reaction is slightly acid or medium acid. Available phosphorus is very low to low and available potassium is very low in the subsoil. Tilth ranges from poor in the Armstrong soil to good in the Gara soil.

Most areas of these soils are in pasture or hay; a few places are in woodland. These soils are best suited to adapted grasses and trees. Because farm machinery can be used in most areas of these soils, hay can also be grown. Erosion is a serious hazard, and wetness is a hazard in many of these soils. Gullies are common.

When these soils are used for pasture or trees, controlled grazing is important to maintain good stands and to control erosion. Grazing when the soil is too wet causes compaction, which increases runoff and erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture in good condition.

These soils are moderately suited to trees. A plant cover should be maintained to reduce erosion. Special equipment might be needed because of the steep slopes.

These soils are in capability subclass VIe.

1220—Nodaway-Ackmore silt loams, channeled, 0 to 2 percent slopes. These soils are on first bottom lands. They are stratified, silty alluvium. The soils are subject to flooding, and some oxbows are filled with water for long periods. The Nodaway soil is moderately well drained and the Ackmore soil is somewhat poorly drained and poorly drained. Generally the individual areas are about 60 percent Nodaway silt loam and 30 percent Ackmore silt loam. They are irregular in shape or long and broad. They range from 20 to 100 acres or more in size.

Typically the Nodaway soil has a surface layer that is very dark grayish brown slit loam with a few thin, grayish

brown and light brownish gray strata. It is about 7 inches thick. The substratum is very dark grayish brown silt loam with stratified lenses to a depth of 38 inches. The next layer is black to very dark gray silty clay loam to a depth of 60 inches.

Typically the Ackmore soil has a surface layer that is very dark grayish brown silt loam about 6 inches thick. The substratum is stratified very dark gray and dark grayish brown, friable silt loam to a depth of 25 inches. The next layer is black and very dark gray silty clay loam to a depth of 60 inches. In some places the substratum exceeds 30 inches in thickness.

Included with these soils in mapping are small areas of Colo or Zook soils that have plane to concave slopes. The soils are wetter than Nodaway and Ackmore soils and tend to be ponded after rains. In some places a few small areas of somewhat poorly drained Lawson silt loam are near the major streams in the southeastern part of the county. Inclusions make up less than 10 percent of this unit.

Permeability in these Nodaway and Ackmore soils is moderate. These soils have a seasonal high water table. Runoff is slow. Generally reaction in the surface layer is slightly acid or neutral. Available phosphorus is medium to low and available potassium is medium to very low in the subsoil. Available water capacity in these soils is high. The shrink-swell potential is moderate. Organic matter in the surface layer of these soils is 2 to 4 percent. Generally tilth is good.

Most areas of these soils are in pasture. These soils are not suited to corn, soybeans, and small grains unless the wetness and the hazard of flooding are controlled. They are best suited to pasture, trees, and wildlife habitat.

These soils can be used for pasture or hay. Overgrazing or grazing when the soils are wet causes compaction, which results in poor tilth and reduces production of desirable grasses. Proper stocking, pasture rotation, and timely deferment of grazing help keep the pasture and soil in good condition.

These soils are well suited to trees. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed. This can be accomplished by site preparation; by prescribed burning; or by spraying, cutting, or girdling.

These soils are in capability subclass Vw.

5030—Quarries, limestone. This map unit consists of excavated areas where limestone is being removed and stockpiled for agricultural and commercial use. The waste material is usually deposited on the outer rim of the area. The areas are irregular in shape and 10 and 20 acres in size.

These quarries are expanding in size and are supplying crushed rock for roads and construction of buildings. One of the quarries, east of Grinnell and north of Malcom, has underground excavations or tunnels. The other quarry, in the south-central part of the county near the southern boundary, is an open pit.

5040—Orthents, loamy. This map unit consists of borrow areas. Most of these areas are near the interstate highway. They range in size from 3 acres to 5 acres. In many places the upper part of the soil has been removed to a depth of several feet, and in some places the topsoil was incorporated with the underlying material.

Some of the areas are cultivated, but they are not well suited to crop production. These areas are best suited to grasses and legumes, which help rebuild the soil. The addition of organic residue and needed commercial fertilizer can be a benefit to this type of land.

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 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.

More than 300,000 acres in the county was used for harvested crops and pasture in 1974, according to the 1974 Iowa Agriculture Statistics (*16*). Of this total, over 56,000 acres was used for permanent pasture; about 180,000 acres for row crops, mainly corn and soybeans; 23,000 acres for oats; and about 37,000 acres for rotation hay and pasture.

The potential of the soils of the county for increased production of food is good. About 8,000 acres is currently used as woodland, and some of this is also used as pasture. In addition to the reserve productive capacity represented by this land, food production could be increased considerably by extending the latest crop production technology to all cropland in the county. This soil survey can facilitate the application of such technology.

Acreage in crops and pasture has gradually been decreasing in recent years as more and more land is used for urban development. In 1969 there was about 358,500 acres of farmland. In 1974 there was 368,841 acres in farmland. Since then this figure has been decreasing. In 1977 there was 350,200 acres in farms. The use of this soil survey to help make land use decisions that will influence the future role of farming in the county is discussed in the section "General soil map units."

Soil erosion is the major soil problem on about three-fourths of the cropland and pasture in Poweshiek County. If the slope is more than 2 percent, erosion is a hazard.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils that have a clayey subsoil. Erosion also reduces productivity on soils that tend to be droughty. Second, soil erosion on farmland results in sediment entering streams. Control of erosion minimizes the pollution of streams by sediment and improves the quality of water for municipal use, for recreation, and for fish and wildlife.

In many sloping fields, preparing a good seedbed and tilling are difficult in spots that are clayey because the original, friable surface soil has been eroded away. Such spots are common in moderately eroded soils.

Erosion control practices provide protective surface cover, reduce runoff, and increase infiltration. A cropping

system that keeps vegetative cover on the soil for extended periods can hold soil erosion losses to amounts that do not reduce the productive capacity of the soils. On livestock farms, which require pasture and hay, the legume and grass forage crops in the cropping system reduce erosion on slopes and also provide nitrogen and improve tilth for the following crop.

In some areas slopes are so short and irregular that contour tillage or terracing is not practical. On these soils cropping systems that provide substantial vegetative cover are required to control erosion unless minimum tillage is practiced. Minimizing tillage and leaving crop residue on the surface help increase infiltration and reduce the hazards of runoff and erosion. These practices can be adapted to most soils in the survey area but are more difficult to use successfully on the eroded soils and on the soils that have a clayey surface layer. Not tilling corn, which is common on an increasing acreage, is effective in reducing erosion on slopes and can be adapted to many soils in the survey area. It is more difficult to practice successfully, however, on the soils that have a clayey surface layer.

Terraces and diversions reduce the length of slope and reduce runoff and erosion. They are most practical on deep, well drained soils that have regular slopes. Soils that have irregular slopes, excessive wetness in the terrace channels, or a clayey subsoil that is exposed in terrace channels, are less suitable for terracing and diversions.

Contour farming and contour stripcropping are erosion control practices in the survey area. They are best adapted to soils that have smooth, uniform slopes.

Soil blowing is a hazard on the sandy soils. Soil blowing can damage these soils in a few hours if winds are strong and the soils are dry and bare of vegetation or surface mulch. Maintaining vegetative cover, surface mulch, or rough surfaces through proper tillage minimizes soil blowing on these soils.

Information on controlling erosion for each kind of soil is contained in the Technical Guide, available in local offices of the Soil Conservation Service.

Soil drainage is the major management need on many of the bottom lands and the level uplands used for crops and pasture in the county. Some soils are naturally so wet that the production of crops common to the area is generally not possible. These are some of the poorly drained and very poorly drained soils, which make up about 42,000 acres. Unless artificially drained, the poorly drained soils and some of the somewhat poorly drained soils are so wet that crops are damaged during most years.

Some soils have good natural drainage most of the year, but they tend to dry out slowly after rains. Small areas of wetter soils along drainageways and in swales are commonly included in areas of moderately well drained and somewhat poorly drained soils, especially those that have slopes of 2 to 5 percent. Artificial drainage is needed in most of these wetter soils.

The design of both surface and subsurface drainage systems varies with the kind of soil. A combination of surface and subsurface drains is needed in most areas of the poorly drained and the very poorly drained soils used intensively for row cropping. Drains have to be more closely spaced in soils that have slow permeability than in the more permeable soils. Subsurface drains work very slowly in soils that have the clay content high in the subsoil. Finding adequate outlets for subsurface drainage systems is difficult in some bottom-land areas. Information on the design of drainage systems for each kind of soil is contained in the Technical Guide, available in local offices of the Soil Conservation Service.

Soil fertility is naturally low in many soils of the uplands. Most soils are naturally acid. If they have never been limed, they require applications of ground limestone to raise the pH level sufficiently to grow alfalfa and other crops that need a nearly neutral soil. Available phosphorus and potash levels are naturally low in many of these soils. On all soils, additions of lime and fertilizer should be based on the results of soil tests, on the need of the crop, and on the expected level of yields. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime to apply.

Soil tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils that have good tilth are granular and porous.

Most of the soils used for crops in the survey area have a surface layer of silt loam or silty clay loam that is dark in color and moderate in content of organic matter. The moderately eroded and severely eroded soils have a surface layer that is lower in organic matter content and higher in clay content than the uneroded phase. Generally the structure of such soils is weak, and intense rainfall causes the formation of a crust on the surface. The crust is hard when it is dry, and it is nearly impervious to water. Once the crust forms, it reduces infiltration and increases runoff. Regular additions of crop residue to the surface and manure and other organic material into the plow layer can improve soil tilth and reduce crust formation.

yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

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

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting

and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

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 grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

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

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight 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 rnake 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, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is shown in table 6. The capability classification of each map unit is given in the section "Detailed soil map units."

woodland management and productivity

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 (woodland suitability) 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 important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: x, w, t, d, c, s, f, and r.

In table 7, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road

construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

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

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

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

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

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

windbreaks and environmental plantings

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

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold 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 insure 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 nursery.

recreation

Since 1956 a total of 732 acres has been set aside for recreation by the Poweshiek County Conservation Board. Diamond Lake County Park is 1 of 11 parks and recreational areas that are being preserved by the board (fig. 6).

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

Figure 6.—Diamond Lake is used for recreation and water supply for Montezuma.

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

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

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

Paths and trails for hiking, horseback riding, and bicycling 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

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

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

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

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

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

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

Coniferous plants furnish browse, seeds, and cones. 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, 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, 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 soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

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

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

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

building site development

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

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

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

properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

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

sanitary facilities

Table 12 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

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

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

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

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

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

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

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

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

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth

of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

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

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

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

construction materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

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

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

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

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

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

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

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable sources of sand and gravel. 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 16 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

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

Soils rated *good* have friable loamy material to a depth of at least 16 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 8 to

16 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 8 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

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

water management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

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

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

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

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

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

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

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

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

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

soil properties

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

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

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

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

engineering index properties

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

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

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

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

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

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

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

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 oven-dry 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 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 earth-moving operations.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

soil and water features

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

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

The four hydrologic soil groups are:

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

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

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

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

Flooding, the temporary inundation of an area, is caused by overflowing streams and by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes are not considered flooding.

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

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of 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 is local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An

artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

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

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

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are 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 (*15*). 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. In table 18, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

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

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udoll (*Ud*, meaning humid, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Argiudolls (*Argi*, meaning argillic horizonation, plus *udoll*, the suborder of the Mollisols that have an udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Argiudolls.

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

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

soil series and their morphology

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

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*13*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*15*). 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. They formed in alluvium on flood plains or in alluvial fans on the bottom land. They formed under a native vegetation of grasses. Slopes range from 0 to 2 percent.

Ackmore soils are similar to Nodaway soils and are commonly adjacent to Lawson, Colo, and Zook soils on the bottom lands. Nodaway soils do not have the dark, buried A horizon within a depth of 36 inches that the Ackmore soils have. Colo, Lawson, and Zook soils have a mollic epipedon.

Typical pedon of Ackmore silt loam, 0 to 2 percent slopes, on bottom land, in a cultivated field; 1,375 feet east and 20 feet north of the center of sec. 4, T. 78 N., R. 13 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.
C1—6 to 25 inches; stratified very dark gray (10YR 3/1) and dark grayish brown (10YR 4/2) silt loam, dark grayish brown (10YR 4/2) dry; few fine distinct yellowish brown (10YR 5/6) mottles; weak thin platy structure; friable; neutral; clear smooth boundary.
IIA11b—25 to 33 inches; black (N 2/0) silty clay loam; weak fine subangular blocky structure parting to weak fine granular; firm; few fine and coarse dark accumulations of iron and manganese oxides; neutral; gradual smooth boundary.
IIA12b—33 to 60 inches; black (N 2/0) and very dark gray (N 3/0) silty clay loam; massive; firm; few fine and coarse dark accumulations of iron and manganese oxides; neutral.

The A horizon is black (10YR 2/1), very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) silt loam or light silty clay loam. The strata in the C horizon range from black (10YR 2/1) to grayish brown (10YR 5/2). The C horizon is silt loam or light silty clay loam. The buried IIA horizon typically is silty clay loam but ranges to silt loam. In some pedons it has a value of 4 and chroma of 1 or 2 below a depth of 48 inches. In most of these soils, the substratum is neutral or slightly acid.

Adair series

The Adair series consists of moderately well drained or somewhat poorly drained, slowly permeable soils . These soils are in uplands. They formed in a reddish, fine textured exhumed paleosol. The upper part of the soil profile, above the stone line, formed in loess or pedisediment and under a native vegetation of prairie grasses. At one time this was a buried soil, but it recently has been exposed by erosional processes. Slopes range from 9 to 14 percent.

Adair soils are similar to the Armstrong and Keswick soils and commonly are adjacent to Shelby and Tama soils. The Armstrong and Keswick soils have an A2 horizon. The Keswick soils do not have a mollic epipedon. Adair soils have more than 35 percent clay in the IIB2t horizon; in contrast, Shelby soils have 30 to 35 percent clay in the B2t horizon. Shelby soils are downslope from Adair soils, and Tama soils are upslope. Tama soils formed in loess.

Typical pedon of an uneroded Adair clay loam in an area of Adair clay loam, 9 to 14 percent slopes, moderately eroded, in a permanent pasture; 460 feet west and 1,480 feet north of the southeast corner of sec. 19, T. 80 N., R. 16 W.

A1—0 to 8 inches; black (10YR 2/1) and very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry, very dark grayish brown (10YR 3/2) kneaded; weak fine granular structure; friable; neutral; gradual smooth boundary.
B1—8 to 11 inches; very dark gray (10YR 3/1) and reddish brown (5YR 4/3 loam, dark grayish brown (10YR 4/2) dry, very dark grayish brown (10YR 3/2) kneaded; weak fine granular structure; friable; neutral; clear smooth boundary.
B21t—11 to 15 inches; very dark gray (10YR 3/1) clay loam mixed with reddish brown (5YR 4/4), very dark grayish brown (10YR 3/2) kneaded; weak very fine granular structure; friable; medium acid; clear smooth boundary.
IIB22t—15 to 23 inches; reddish brown (5YR 4/4) light clay loam, reddish brown (5YR 4/3, 4/4) kneaded; few fine distinct dark red (2.5YR 3/6) mottles; weak fine and medium subangular blocky structure; firm; few small pebbles; strongly acid; gradual smooth boundary.
IIB23t—23 to 30 inches; mottled dark yellowish brown (10YR 4/4) and dark red (2.5YR 3/6) light clay; moderate fine subangular blocky structure; firm; thin discontinuous clay films; few small pebbles; strongly acid; gradual smooth boundary.
IIB31t—30 to 36 inches; yellowish brown (10YR 5/4) light clay; few fine distinct yellowish red (5YR 4/6) mottles; moderate fine subangular blocky structure; firm; thin discontinuous clay films; few fine dark oxides; few small pebbles; strongly acid; gradual smooth boundary.
IIB32t—36 to 42 inches; brown (10YR 5/3) and yellowish brown (10YR 5/4) light clay; few fine faint grayish brown (10YR 5/2) and few fine distinct yellowish red (5YR 5/6) mottles; moderate medium subangular blocky structure; firm; thin discontinuous clay films; slightly acid; gradual smooth boundary.
IIB33t—42 to 54 inches; yellowish brown (10YR 5/4) heavy clay loam, few fine distinct yellowish red (5YR 5/6) and common fine faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; thin discontinuous clay films; neutral; gradual smooth boundary.
IIB34t—54 to 60 inches; brown (10YR 5/3) and yellowish brown (10YR 5/4) clay loam; few fine distinct reddish brown (5YR 4/4) mottles; moderate medium subangular blocky and angular blocky structure; friable; few dark oxides; neutral.

The solum ranges from 40 to 60 inches or more in thickness. It has carbonates at a depth of 4 to 5 feet in some places. The mollic epipedon ranges from 10 to 16 inches in thickness and from medium acid to neutral.

The A horizon ranges from black (10YR 2/1) to very dark gray (10YR 3/1) to very dark grayish brown (10YR

3/2) or very dark brown (10YR 2/2). It ranges from clay loam or silty clay loam to silt loam or loam. A band of pebbles is usually in the upper part of the B horizon, but in places it is at the base of the A horizon. The IIB2t horizon has few mottles in the upper part and many mottles in the lower part. These mottles are dark grayish brown (10YR 4/2), grayish brown (2.5Y 5/2), yellowish red (5YR 4/6), dark red (2.5YR 3/6), and yellowish brown (10YR 5/6). The IIB2 horizon is 38 to 46 percent clay. The IIC horizon has common to many mottles that have low chroma.

Amana series

The Amana series consists of somewhat poorly drained, moderately permeable soils on flood plains. These soils formed in silty alluvium and under a native vegetation of prairie grasses. Slopes range from 0 to 2 percent.

Amana soils are adjacent to Koszta, Nodaway, Vesser, Colo, and Zook soils. Koszta soils are at slightly higher elevations on the landscape, so are less likely to be flooded. Nodaway soils are adjacent to the main stream. Vesser soils are on parts of the bottom lands that are near and within the meander belt of the stream. Colo and Zook soils are at slightly lower elevations. They are away from the main stream channel and close to the foot slopes of uplands.

Typical pedon of Amana silt loam, 0 to 2 percent slopes, in a cultivated field; 950 feet east and 2,185 feet north of the southwest corner of sec. 2, T. 81 N., R. 13 W.

Ap—0 to 7 inches; black (10YR 2/1) silt loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.

A12—7 to 10 inches; black (10YR 2/1) heavy silt loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; slightly acid; gradual smooth boundary.

A3—10 to 15 inches; black (10YR 2/1) and very dark brown (10YR 2/2) heavy silt loam, very dark grayish brown (10YR 3/2) dry, very dark gray (10YR 3/1) kneaded; moderate fine granular structure; friable; medium acid; clear smooth boundary.

B1—15 to 20 inches; dark grayish brown (10YR 4/2) heavy silt loam, very dark grayish brown (10YR 3/2) kneaded; very dark gray (10YR 3/1) faces of peds; weak very fine subangular blocky structure; friable; medium acid; gradual smooth boundary.

B21—20 to 30 inches; dark grayish brown (10YR 4/2) silt loam; very dark gray (10YR 3/1) and dark gray (10YR 4/1) faces of peds; few fine distinct yellowish brown (10YR 5/4) and strong brown (7.5YR 5/8) mottles; moderate fine subangular blocky structure; friable; thin discontinuous light brownish gray (10YR 6/2) silt coatings; few fine oxides; medium acid; gradual smooth boundary.

B22—30 to 38 inches; dark grayish brown (10YR 4/2) silt loam; many fine distinct dark brown (7.5YR 4/4) mottles; moderate fine subangular blocky structure; thin discontinuous light brownish gray (10YR 6/2) silt coatings; few fine oxides; slightly acid; gradual smooth boundary.

B31—38 to 44 inches; grayish brown (2.5Y 5/2) silt loam; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak coarse subangular blocky structure; friable; thin discontinuous light brownish gray (10YR 6/2) silt coatings; few fine oxides; slightly acid; gradual smooth boundary.

B32—44 to 55 inches; grayish brown (2.5Y 5/2) silt loam that is high in content of sand; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak coarse subangular blocky structure; thin discontinuous light brownish gray (10YR 6/2) silt coatings; few fine oxides; slightly acid; gradual smooth boundary.

C—55 to 60 inches; grayish brown (2.5Y 5/2) silt loam that is high in content of sand; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak coarse prismatic structure; friable; thin discontinuous light brownish gray (10YR 6/2) silt coatings; few fine oxides; slightly acid.

The solum ranges from 30 to 65 inches in thickness. In most places it is more than 40 inches thick. It typically is medium acid or strongly acid in the most acid parts. Stratification is weak to a depth of about 40 inches, but a few thin lenses of sandy loam or loam are below this depth.

The A horizon is 10 to 20 inches thick. It is black (10YR 2/1), very dark brown (10YR 2/2), or very dark gray (10YR 3/1) silt loam or silty clay loam. The B horizon is dark grayish brown (10YR or 2.5Y 4/2) or grayish brown (10YR or 2.5Y 5/2) silt loam or light silty clay loam. Mottles that have value of 4 or 5 and chroma of 4 through 8 are throughout the B horizon. The C horizon is dark grayish brown (2.5Y 4/2), grayish brown (2.5Y 5/2 or 5/1), or olive gray (5Y 4/2 or 5/2). It is loam or silt loam.

Armstrong series

The Armstrong series consists of moderately well drained or somewhat poorly drained, slowly permeable soils. These soils are in uplands. They formed in a reddish, fine textured exhumed paleosol. The upper part of the soil profile, above the stone line, formed in loess or pedisediment and under a native vegetation of grass and trees. At one time this was a buried soil, but it recently has been exposed by erosional processes. Slopes range from 9 to 14 percent.

Armstrong soils are similar to Adair and Keswick soils and commonly adjacent to Downs, Gara, Ladoga, and Lindley soils. Adair soils do not have an A2 horizon but do have a mollic epipedon. Keswick soils have a thinner

A1 horizon than Armstrong soils. Downs and Ladoga soils are upslope from Armstrong soils and formed in loess. Gara and Lindley soils are downslope from Armstrong soils. They do not have the reddish hues of 5YR. Armstrong soils have more than 35 percent clay in the IIB2 horizon, and Gara and Lindley soils have 30 to 35 percent clay in the B2 horizon.

Typical pedon of Armstrong loam, 9 to 14 percent slopes, moderately eroded, that is on west-facing, convex slopes, in alfalfa; 900 feet north and 2,355 feet east of the southwest corner of the southwest quarter sec. 35, T. 76 N., R. 13 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) and grayish brown (10YR 5/2) loam, grayish brown (10YR 5/2) mixed with some light gray (10YR 7/2) dry; weak fine granular structure; friable; neutral; abrupt boundary.

B1—7 to 14 inches; dark yellowish brown (10YR 4/4) loam; weak fine subangular blocky structure; friable; neutral; gradual smooth boundary.

B21t—14 to 24 inches; brown (7.5YR 5/4) clay loam; few fine faint grayish brown (10YR 5/2) mottles; moderate fine subangular blocky structure; firm; thin discontinuous silt coatings and clay films on faces of peds; stone line at base of horizon; slightly acid; clear smooth boundary.

IIB22t—24 to 30 inches; mottled strong brown (7.5YR 5/6) and grayish brown (10YR 5/2) heavy clay loam; few fine prominent red (2.5YR 4/6) mottles; moderate fine subangular blocky structure; firm; thin discontinuous silt coatings and clay films; few fine distinct black oxides; medium acid; gradual smooth boundary.

IIB23t—30 to 37 inches; mottled strong brown (7.5YR 5/6) and grayish brown (10YR 5/2) clay loam; common fine distinct red (2.5YR 5/6) mottles; moderate fine subangular blocky structure; firm; thin discontinuous clay films; medium acid; gradual smooth boundary.

IIB31t—37 to 50 inches; yellowish brown (10YR 5/6) clay loam; common fine distinct yellowish red (5YR 5/6) and few fine faint grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; thin discontinuous clay films; few fine distinct black oxides; medium acid; gradual smooth boundary.

IIB32—50 to 60 inches; yellowish brown (10YR 5/6) clay loam; few fine faint grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; thin discontinuous clay films on faces of peds; common fine distinct black oxides; slightly acid.

The solum ranges from 42 to 60 inches or more in thickness. It has glacial stones and pebbles throughout.

The A1 or Ap horizon is black (10YR 2/1), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2) silt loam, loam, silty clay loam, or clay loam. In cultivated areas the A2 horizon is usually mixed into the Ap horizon. The A2 horizon is grayish brown (10YR 5/2) or dark grayish brown (10YR 4/2) loam or silt loam. The IIB2t horizon is 12 to 30 inches thick. It has a maximum clay content of 36 to 48 percent. The stone or pebble band is above the clay accumulation. The IIB2 horizon centers on hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 3 through 6. If present, the IIB3 and IIC horizons have hue of 10YR, value of 4 to 5, and chroma of 3 to 6. They are 30 to 36 percent clay.

Atterberry series

The Atterberry series consists of somewhat poorly drained, moderately permeable soils on loess-covered divides of uplands. These soils formed in loess and under a native vegetation of forest and prairie grasses. Slopes range from 0 to 2 percent.

Atterberry soils are similar to Muscatine soils and are commonly adjacent to Downs, Muscatine, and Fayette soils in the landscape. Muscatine soils have a mollic epipedon up to 20 inches thick. Downs and Fayette soils are well drained. They do not have chroma of 2 in the matrix of the subsoil.

Typical pedon of Atterberry silt loam, 0 to 2 percent slopes, 2,080 feet west and 500 feet north of the southeast corner of sec. 23, T. 81 N., R. 14 W.

Ap—0 to 8 inches, very dark grayish brown (10YR 3/2) silt loam mixed with some grayish brown (10YR 5/2), dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.

A2—8 to 15 inches, grayish brown (10YR 5/2) silt loam; moderate thin platy structure; friable; medium acid; clear smooth boundary.

B1t—15 to 20 inches, brown (10YR 4/3) light silty clay loam; few fine distinct yellowish brown (10YR 5/4) and gray (10YR 6/1) mottles; weak medium subangular blocky structure; firm; thin discontinuous light gray (10YR 7/2) silt coatings on faces of peds; strongly acid; clear smooth boundary.

B21t—20 to 28 inches, grayish brown (10YR 5/2) silty clay loam; common fine distinct yellowish brown (10YR 5/4, 5/6) and common fine faint light brownish gray (10YR 6/2) mottles; moderate fine and medium subangular blocky structure; firm; thin nearly continuous clay films and light gray (10YR 7/2) silt coatings on faces of peds; few concretions of iron and manganese; strongly acid; gradual smooth boundary.

B22t—28 to 33 inches, grayish brown (10YR 5/2) silty clay loam; common medium distinct yellowish brown (10YR 5/8) mottles; moderate fine and medium subangular blocky structure; firm; thin nearly continuous clay films and light gray (10YR 7/2) silt coatings on faces of peds; few concretions of iron and manganese; strongly acid; gradual smooth boundary.

B23t—33 to 38 inches, grayish brown (10YR 5/2) silty clay loam; common medium distinct yellowish brown (10YR 5/8) mottles; weak medium and coarse subangular blocky structure; firm; thin nearly continuous clay films and light gray (10YR 7/2) silt coatings on faces of peds; few concretions of iron and manganese; medium acid; gradual smooth boundary.

B31—38 to 44 inches, grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4) light silty clay loam; many medium distinct yellowish brown (10YR 5/8) mottles; weak medium and coarse subangular blocky structure; friable; thin discontinuous clay films on faces of peds; few concretions of iron and manganese; medium acid; gradual smooth boundary.

B32—44 to 54 inches, grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4) light silty clay loam; many medium distinct yellowish brown (10YR 5/6, 5/8) mottles; weak coarse subangular blocky structure; friable; thin discontinuous clay films on faces of prisms; few concretions of iron and manganese; medium acid; gradual smooth boundary.

C—54 to 60 inches, grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4) silt loam; many medium distinct yellowish brown (10YR 5/6 or 5/8) mottles; massive; friable; few concretions of iron and manganese; slightly acid.

The solum ranges from 40 to 60 inches or more in thickness. The Ap horizon is black (10YR 2/1), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). It is 4 to 8 inches thick. The A2 horizon ranges from dark grayish brown (10YR 4/2) to grayish brown (10YR 5/2). It is 4 to 9 inches thick. The B horizon has hue of 10YR or 2.5Y, value of 4 through 6, and chroma of 2 or 4. Chroma is mostly 2.

Bremer series

The Bremer series consists of poorly drained, moderately slowly permeable soils. These soils formed in silty and clayey alluvium on low benches or second bottom lands along streams. They formed under a native vegetation of prairie grasses. Slopes range from 0 to 2 percent.

Bremer soils are adjacent to Colo, Nevin, Wiota, and Zook soils. Colo and Zook soils have an A horizon that is more than 20 inches thick. The Colo, Nevin, and Wiota soils have less clay in the subsoil than the Bremer soils. Nevin and Wiota soils are the somewhat poorly drained and the moderately well drained members, respectively, of the same drainage sequence as the Bremer soils.

Typical pedon of Bremer silty clay loam, 0 to 2 percent slopes, 1,800 feet north and 250 feet west of the southeast corner of sec 19, T. 78 N., R. 16 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; slightly acid; gradual smooth boundary.

A12—8 to 16 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky and weak fine granular structure; friable; neutral; gradual smooth boundary.

B21t—16 to 24 inches; very dark gray (N 3/0) silty clay loam, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate fine subangular blocky; firm; few roots and pores; thin discontinuous black clay films on faces of peds; neutral; gradual smooth boundary.

B22t—24 to 30 inches; very dark gray (N 3/0) light silty clay, dark gray (10YR 4/1) dry; few fine distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure parting to moderate fine and medium subangular blocky; firm; few roots and pores; thin discontinuous black (N 2/0) clay films on faces of peds; neutral; gradual smooth boundary.

B23tg—30 to 36 inches; dark grayish brown (2.5Y 4/2) light silty clay; common fine distinct strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure parting to moderate medium and fine subangular blocky; firm; few roots and pores; thin discontinuous very dark gray (10YR 3/1) clay films and tongues of black (N 3/0) clay films on faces of peds; neutral; gradual smooth boundary.

B24tg—36 to 45 inches; dark grayish brown (2.5Y 4/2) light silty clay; common fine distinct strong brown (7.5YR 5/6) and many fine and medium yellowish brown (10YR 5/4) mottles; weak coarse prismatic structure; firm; few roots and pores; many dark colored accumulations; thin discontinuous very dark gray (10YR 3/1) clay films and tongues of black (N 3/0) clay films on faces of peds; neutral; gradual smooth boundary.

B3g—45 to 50 inches; mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/4, 5/6) heavy silty clay loam; few fine distinct strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure; firm; thin nearly continuous grayish brown (10YR 5/2) clay films and tongues of black (N 2/0) clay flows along root channels; many dark colored accumulations; neutral; clear smooth boundary.

Cg—50 to 60 inches; gray (5Y 6/1) silty clay loam; many fine and medium distinct yellowish brown (10YR 5/4, 5/6) mottles; massive; firm; black (N 3/0) clay flows along root channels; many dark colored accumulations; neutral.

The solum ranges from 40 inches to 60 inches or more in thickness. It has no carbonates to a depth of 60 inches or more.

The A horizon is black (N 2/0 or 10YR 2/1) or very dark gray (N 3/0). It ranges from 14 to 20 inches in thickness. The B horizon commonly has value of 3, but

the value increases to 4 or 5 as depth increases. Chroma is 1 or less to a depth of 24 to 36 inches. The upper 20 inches of the argillic horizon is 36 to 40 percent clay.

Caleb series

The Caleb series consists of moderately well drained, moderately permeable soils formed in water-sorted glacial sediment. These soils are adjacent to the major stream valleys. They formed under mixed vegetation of grass and forest. Slopes range from 9 to 14 percent.

Caleb soils are adjacent to Mystic soils. Mystic soils have a finer textured B2t horizon of redder hue and lower chroma. Mottles begin at a shallower depth. Mystic soils are generally at higher elevations on the landscape than Caleb soils.

Typical pedon of Caleb loam, 9 to 14 percent slopes, moderately eroded, in a pasture 980 feet east and 660 feet north of the southwest corner of sec. 18, T. 78 N., R. 14 W.

Ap—0 to 6 inches; mixed very dark grayish brown (10YR 3/2), grayish brown (10YR 5/2), and brown (10YR 4/3) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; slightly acid; clear smooth boundary.

B1—6 to 12 inches; brown (10YR 4/3) light sandy clay loam; few fine distinct yellowish brown (10YR 5/4, 5/6) mottles; moderate medium subangular blocky structure; friable; thin discontinuous light gray (10YR 7/2) silt coatings and very dark grayish brown (10YR 3/2) clay films; few fine dark oxides; strongly acid; clear smooth boundary.

B21t—12 to 26 inches; brown (10YR 5/3) light sandy clay loam; few fine distinct yellowish brown (10YR 5/4, 5/6) mottles; moderate medium subangular blocky structure; firm; thin discontinuous light gray (10YR 7/2) silt coatings and very dark grayish brown (10YR 3/2) clay films on faces of peds; few fine distinct dark oxides; strongly acid; clear smooth boundary.

B22t—26 to 36 inches; yellowish brown (10YR 5/4) sandy clay loam; few fine distinct grayish brown (10YR 5/2) mottles; weak coarse prismatic structure; friable; thin discontinuous light gray (10YR 7/2) silt coatings and very dark grayish brown (10YR 3/2) clay films on faces of peds; few fine distinct dark oxides; very strongly acid; clear smooth boundary.

B3—36 to 60 inches; yellowish brown (10YR 5/4) sandy loam; weak coarse prismatic structure; friable; thin discontinuous light gray (10YR 7/2) silt coatings on faces of peds; thin dark colored bands in sandy strata; medium acid.

The solum is usually 5 feet or more thick. It ranges from medium acid to very strongly acid in the most acid part. In uneroded parts of an eroded area, the Ap or A1 horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). If present, it ranges from 6 to 9 inches thick. The A2 horizon generally ranges from dark grayish brown (10YR 4/2) to brown (10YR 5/3) and is 2 to 6 inches thick. The upper part of the B2t horizon ranges from brown (10YR 4/3, 5/3) to yellowish brown (10YR 5/6). The B2t horizon is clay loam or sandy clay loam and has thin strata of sandy loam or loamy sand. The next horizon is fine sandy loam or sandy clay loam. In places there are strata of coarse materials.

Chelsea series

The Chelsea series consists of excessively drained, rapidly permeable soils that formed in eolian sand and under a native vegetation of forest. These soils are on ridges and side slopes. They are in uplands. Slopes range from 9 to 25 percent.

Chelsea soils are similar to Sparta soils and are commonly adjacent to Clinton and Ladoga soils. Clinton and Ladoga soils formed in loess and have a silty texture. Sparta soils have a deeper, dark A1 horizon than that of the Chelsea soils. They do not have an A2 horizon.

Typical pedon of Chelsea loamy fine sand in an area of Chelsea-Ladoga complex, 9 to 14 percent slopes, moderately eroded, in a cultivated field; 430 feet west and 600 feet north of the southeast corner of sec. 17, T. 78 N., R. 16 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2), dark brown (10YR 3/3), and brown (10YR 4/3) loamy fine sand, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; neutral; abrupt smooth boundary.

A21—7 to 19 inches; brown (10YR 4/3) loamy fine sand; single grain; loose; neutral; clear smooth boundary.

A22—19 to 36 inches; yellowish brown (10YR 5/4) fine sand; single grain; loose; neutral; gradual smooth boundary.

A & B—36 to 60 inches; yellowish brown (10YR 5/4) and brown (10YR 5/3) fine sand; single grain; loose; 1/2-inch bands of brown (7.5YR 5/4) light sandy loam, bands are less than 6 inches total; neutral.

The solum is 4 feet or more thick. It does not have carbonates to a depth of 60 inches or more.

The Ap or A1 horizon ranges considerably in color from very dark grayish brown (10YR 3/1) to dark brown (10YR 3/3) and brown (10YR 4/3). It is typically loamy fine sand, but in some places it is fine sand. The A2 horizon is brown (10YR 4/3), dark yellowish brown (10YR 4/4) or dark grayish brown (10YR 4/2) in the upper part and dark yellowish brown (10YR 4/4) to light yellowish brown (10YR 6/4) in the lower part. It ranges from loamy fine sand to fine sand. Lamellae are 1/4 inch to 2 inches thick and are brown (7.5YR 4/4 and 5/4)

and some dark yellowish brown (10YR 3/4). Their total thickness is less than 6 inches.

Clarinda series

The Clarinda series consists of poorly drained, very slowly permeable soils. These soils formed in weathered glacial till and under a native vegetation of prairie grasses. A deposit of loess covered the weathered glacial till, but geologic erosion removed the loess in many places and exposed the old, gray clay. These buried or once-buried soils are paleosols. Slopes range from 5 to 14 percent.

Clarinda soils are adjacent to Lamoni, Adair, Killduff, Otley, Shelby, and Tama soils. The Adair soils have more sand in the solum than the Clarinda soil has. They also have reddish hues and a stone line. Lamoni soils have a thinner IIB horizon than the Clarinda soil. It has chroma of 2 and mottles with chroma of 1. Killduff, Otley, and Tama soils formed in loess, and Shelby soils formed in loamy glacial till. The Shelby soils usually are steeper than the Clarinda soils.

A typical pedon of Clarinda silty clay loam, 5 to 9 percent slopes in an alfalfa field, 1,920 feet north and 400 feet west of the northeast corner of the southeast quarter of sec. 33, T. 81 N., R. 16 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry, very dark grayish brown (10YR 3/2) kneaded; weak very fine and fine granular structure; neutral; gradual smooth boundary.

A3—6 to 10 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable; very dark gray (10YR 3/1) coatings; slightly acid; gradual smooth boundary.

IIB1t—10 to 14 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) silty clay, very dark grayish brown (10YR 3/2) kneaded; moderate fine subangular blocky structure; firm; medium acid; gradual smooth boundary.

IIB21t—14 to 18 inches; dark gray (10YR 4/1) silty clay, dark grayish brown (10YR 4/2) kneaded; moderate fine subangular blocky structure; very firm; thick continuous clay films; slightly acid; gradual smooth boundary.

IIB22tg—18 to 31 inches; gray (5Y 5/1) silty clay; common fine distinct yellowish brown (10YR 5/6 and 5/8) and common fine prominent strong brown (7.5YR 5/6 and 5/8) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; very firm; thick continuous clay films; some dark gray (10YR 4/1) coatings; slightly acid.

IIB23tg—31 to 45 inches; gray (5Y 5/1) silty clay; few fine distinct yellowish brown (10YR 5/6 and 5/8) and prominent strong brown (7.5YR 5/6 and 5/8) mottles; weak coarse prismatic structure; very firm; thick continuous clay films; few fine dark oxides; slightly acid; gradual smooth boundary.

IIB3tg—45 to 60 inches; gray (5Y 5/1) silty clay; few fine distinct yellowish brown (10YR 5/6 and 5/8) and prominent strong brown (7.5YR 5/6 and 5/8) mottles; weak coarse prismatic structure; very firm; few thick continuous clay films; few fine dark oxides; slightly acid.

The solum is usually more than 60 inches thick.

The A horizon typically formed in loess or silty sediments. Its total thickness ranges from 10 to 18 inches. In some eroded areas the A horizon is less than 10 inches thick. The A horizon ranges in color from black (10YR 2/1) to very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2). The distinctly gleyed part of the IIB horizon has hue of 10YR, 2.5Y, or 5Y; value of 4 or 5; and chroma dominately of 1. The IIB horizon has varying amounts of yellowish brown, strong brown, and yellowish red mottles. In some places the IIB2 horizon is medium acid or strongly acid in the most acid part.

The map units 222C2 and 222D2 are taxadjuncts because they lack a mollic epipedon. This difference, however, does not significantly alter the use or behavior of the soils.

Clinton series

The Clinton series consists of moderately well drained soils that have moderately slow permeability. These soils are on narrow, convex ridgetops and on side slopes. They are in uplands. They formed in loess and under a native vegetation of deciduous trees. Slopes range from 5 to 18 percent.

Clinton soils are similar and commonly adjacent to Ladoga and Lindley soils. Lindley soils are downslope from the Clinton soil. Because the Lindley soils formed in glacial till, they contain gravel and pebbles. Ladoga soils have a thicker A1 horizon than the Clinton soils.

Typical pedon of Clinton silt loam, 5 to 9 percent slopes (fig. 7), in a timbered pasture; 1,520 feet north and 2,240 feet east of the southwest corner of sec. 2, T. 78 N., R. 13 W.

A1—0 to 4 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; moderate very fine granular structure; friable; many fine tree roots; medium acid, abrupt smooth boundary.

A21—4 to 6 inches; dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; few very dark gray (10YR 3/1) peds from A1 horizon; moderate fine platy structure; friable; many fine tree roots and few pores; medium acid; clear smooth boundary.

A22—6 to 10 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate fine platy structure; friable; many fine tree roots and pores; medium acid; clear smooth boundary.

Figure 7.—Clinton silt loam profile showing soil that formed in loess and under trees.

B1t—10 to 14 inches; brown (10YR 4/3) and dark yellowish brown (10YR 4/4) silty clay loam; weak fine and medium subangular blocky structure; friable; many fine tree roots and pores; thin discontinuous light gray silt coatings; strongly acid, gradual smooth boundary.

B21t—14 to 19 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate and strong fine angular and subangular blocky structure; firm; few fine roots and pores; thin discontinuous light gray silt coatings and clay films; strongly acid; gradual smooth boundary.

B22t—19 to 26 inches; dark yellowish brown (10YR 4/4) silty clay loam; strong fine and medium angular and subangular blocky structure; firm; few fine roots and pores; thin discontinuous light gray silt coatings and clay films; strongly acid; gradual smooth boundary.

B23t—26 to 38 inches; yellowish brown (10YR 5/4) silty clay loam; strong medium subangular and angular blocky structure; firm; few fine roots and pores; discontinuous light gray silt coatings; thick continuous clay films; strongly acid; diffuse smooth boundary.

B24t—38 to 46 inches; yellowish brown (10YR 5/4) silty clay loam; few fine distinct strong brown (7.5YR 5/6) mottles; strong medium angular and subangular blocky structure; firm; few fine roots and pores; discontinuous light gray silt coatings; thick continuous clay films; strongly acid; diffuse smooth boundary.

B3—46 to 60 inches; yellowish brown (10YR 5/4) silty clay loam; few fine distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; firm; few fine pores; discontinuous light gray silt coatings; thin discontinuous clay films; strongly acid.

The solum ranges from 42 to 60 inches or more in thickness. The A1 horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). It is up to 5 inches thick. The A2 horizon is 6 to 14 inches thick. When this soil is cultivated or eroded, the A2 horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3). The B2t horizon ranges from 18 to 36 inches in thickness. It is brown (10YR 4/3 or 5/3), dark yellowish brown (10YR 4/4), or yellowish brown (10YR 5/4). It is 36 to 42 percent clay in the finest part.

Colo series

The Colo series consists of poorly drained, moderately permeable soils on alluvial bottom lands (fig. 8). These soils formed in noncalcareous silty sediment and under a native vegetation of prairie grasses. Slopes range from 0 to 2 percent.

Colo soils are similar to Ely, Lawson, and Nodaway soils and are commonly adjacent to Zook and Ackmore soils on the bottom lands. Zook soils have more clay in the subsoil than the Colo soils. Nodaway and Ackmore soils are made up of recent, stratified sediments. Ely or Lawson soils are lighter colored in the subsoil and are better drained than the Colo soil.

Figure 8.—Corn and harvested soybeans on Colo soils. These soils are in capability subclass IIw.

Typical pedon of Colo silty clay loam, 0 to 2 percent slopes, on bottom land; 1,485 feet west and 1,690 feet south of the northeast corner of sec. 36, T. 79 N., R. 16 W.

A1—0 to 8 inches; black (10YR 2/1) silty clay loam, black (10YR 2/1) dry; moderate fine granular structure; friable; neutral; gradual smooth boundary.

A12—8 to 17 inches; black (N 2/0) silty clay loam, black (10YR 2/1) dry; weak fine subangular blocky structure parting to moderate fine granular; friable; neutral; gradual smooth boundary.

A13—17 to 24 inches; black (10YR 2/1) silty clay loam; weak fine and moderate subangular blocky structure; firm; neutral; gradual smooth boundary.

A14—24 to 30 inches; black (10YR 2/1) silty clay loam; weak fine and moderate subangular blocky structure; firm; neutral; gradual smooth boundary.

A15—30 to 36 inches; black (10YR 2/1) silty clay loam weak fine and moderate subangular blocky structure; firm; neutral; gradual smooth boundary.

AC—36 to 50 inches; very dark gray (10YR 3/1) silty clay loam; few fine distinct yellowish brown (10YR 5/8) mottles; weak coarse prismatic structure; firm; neutral; gradual smooth boundary.
Cg—50 to 60 inches; dark gray (10YR 4/1) silty clay loam; few fine distinct yellowish brown (10YR 5/6, 5/8) and strong brown (7.5YR 5/8) mottles; weak coarse prismatic structure; firm; neutral.

The solum ranges from 36 to 54 inches in thickness. It has no carbonates to a depth of 60 inches. The mollic epipedon is 36 or more inches thick. Overwash sediments, 6 to 18 inches thick, are above the dark A horizon in some pedons.

The A horizon has hue of 10YR, 5Y, or N; value of 2 or 3; and chroma of 0 or 1. The horizons below the A horizon usually average between 32 and 35 percent clay. The soil ranges from neutral to medium acid in the upper 12 inches and is neutral or slightly acid below that depth.

Dinsdale series

The Dinsdale series consists of soils that are well drained and moderately permeable. These soils formed in loess over glacial till and under a native vegetation of prairie grasses. They are on convex side slopes. The soils are in uplands. Slopes range from 5 to 14 percent.

These soils are outside the defined range of the Dinsdale series because they do not have the required thickness for a mollic epipedon.

Dinsdale soils are adjacent to Liscomb and Tama soils. Liscomb soils are generally downslope or at low elevations. They formed in friable glacial till. Tama soils have a solum formed in loess. They are generally upslope from Dinsdale soils.

Typical pedon of Dinsdale silty clay loam, 5 to 9 percent slopes, moderately eroded; 1,815 feet east and 1,650 feet north of the southwest corner of sec. 11, T. 81 N., R. 13 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) and brown (10YR 4/3) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to weak very fine granular; friable; many fibrous roots; common worm holes; neutral; clear smooth boundary.
B1—6 to 12 inches; dark brown (10YR 3/3) and brown (10YR 4/3) silty clay loam; very dark grayish brown (10YR 3/2) faces on peds; moderate fine subangular blocky structure; friable; common fibrous roots; thin discontinuous clay films; common worm holes; neutral; gradual smooth boundary.
B2t—12 to 27 inches; brown (10YR 4/3) silty clay loam; weak medium prismatic structure parting to moderate fine subangular blocky; friable; few fibrous roots; thin discontinuous clay films; neutral; clear smooth boundary.
IIB3—27 to 42 inches; yellowish brown (10YR 5/4 or 5/8) loam; few fine distinct light gray (10YR 6/1) mottles inside peds; weak medium prismatic structure; friable; thin discontinuous clay films; neutral; clear smooth boundary.
IIC—42 to 60 inches; yellowish brown (10YR 5/4, 5/6) heavy loam; few fine faint brown (7.5YR 4/4) mottles and few fine distinct light gray (10YR 6/1) mottles inside peds; massive; horizontal cleavage; firm; neutral.

The solum ranges from 42 to 60 inches in thickness. The loess ranges from 18 to 40 inches in thickness.

The A horizon is black (10YR 2/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2). In uneroded areas the A horizon is 10 to 20 inches thick. In eroded areas it is less than 10 inches thick. The upper part of the B horizon is dark brown (10YR 3/3), brown (10YR 4/3), and dark yellowish brown (10YR 4/4). It is medium or light silty clay loam. The IIB horizon is generally yellowish brown and ranges in chroma from 4 through 8. It ranges from loam to light clay loam. In places there are layers of sandy loam or loamy sand as much as 10 inches thick where the loess and till are in contact. The C horizon ranges from heavy loam to clay loam.

Downs series

The Downs series consists of well drained, moderately permeable soils on ridgetops and side slopes. These soils are on uplands and on loess-covered benches adjacent to large streams. They formed in loess and under vegetation of trees and grasses. Slopes range from 2 to 14 percent.

Downs soils are similar to and associated on the landscape with Tama and Fayette soils. All these soils formed in loess. Tama soils have a thicker and darker A1 horizon than the Downs soil. They do not have the A2 horizon that the Downs soil has. The Fayette soils have a thinner A1 horizon and a thicker A2 horizon than the Downs soil.

Typical pedon of Downs silt loam, 9 to 14 percent slopes, in a permanent pasture that has a few hardwood trees; 2,220 feet north and 330 feet west of the southeast corner of sec. 31, T. 80 N., R. 16 W.

A1—0 to 5 inches; very dark gray (10YR 3/1) heavy silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable; medium acid; clear smooth boundary.
A2—5 to 11 inches; dark grayish brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) dry; some very dark grayish brown (10YR 3/2) faces of peds; weak thin platy structure parting to moderate fine granular; friable; strongly acid; clear smooth boundary.
B1t—11 to 16 inches; brown (10YR 4/3) silty clay loam; some dark brown (10YR 3/3) faces of peds; moderate fine and very fine subangular blocky structure; friable; thick discontinuous coatings; thin

discontinuous clay films; medium acid; gradual smooth boundary.
B21t—16 to 24 inches; brown (10YR 5/3) and yellowish brown (10YR 5/4) silty clay loam; some brown (10YR 4/3) faces of peds; moderate fine subangular blocky structure; friable; thin discontinuous silt coatings; thin discontinuous clay films; medium acid; gradual smooth boundary.
B22—24 to 35 inches; yellowish brown (10YR 5/4) silty clay loam; some brown (10YR 4/3) faces on peds; weak coarse prismatic structure parting to weak medium subangular blocky; friable; thin discontinuous silt coatings; thin discontinuous clay films; medium acid; gradual smooth boundary.
B31—35 to 42 inches; brown (10YR 5/3) light silty clay loam; few fine faint grayish brown (2.5Y 5/2) mottles; weak coarse prismatic structure parting to weak medium subangular blocky; friable; thin discontinuous silt coatings; thin discontinuous clay films; few fine dark soft bodies of iron and manganese oxides; medium acid; gradual smooth boundary.
B32—42 to 48 inches; yellowish brown (10YR 5/4) light silty clay loam; few fine faint grayish brown (2.5Y 5/2) mottles; weak coarse prismatic structure parting to weak coarse subangular blocky; friable; thin discontinuous silt coatings; few fine dark soft bodies of iron and manganese oxides; medium acid; gradual smooth boundary.
B33—48 to 60 inches; yellowish brown (10YR 5/4) light silty clay loam; common fine faint grayish brown (2.5Y 5/2) mottles; weak coarse prismatic structure; friable; few fine dark soft bodies of iron and manganese oxides; medium acid.

The solum ranges from 42 to 60 inches or more in thickness. The A1 or Ap horizon typically is from 5 to 9 inches thick. It ranges from very dark brown (10YR 2/2) to very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). The A2 horizon is mixed into the Ap horizon in many pedons. Generally it is dark grayish brown (10YR 4/2) or brown (10YR 5/3). The B horizon is brown (10YR 4/3 or 5/3) in the upper part and grades in value to 4 or 5 and in chroma to 4 or 6 as depth increases. The B2 horizon is from 27 to 35 percent clay.

Downs Variant

The Downs Variant consists of moderately well drained, moderately permeable soils on convex side slopes at the heads of drainageways. These drainageways are near the stable divides. These soils are in uplands. They formed in loess and under a vegetation of trees and grasses. Slopes range from 5 to 14 percent.

The Downs Variant is similar to and associated on the landscape with Downs and Fayette soils. All of these soils formed in loess. Downs soils do not have gray and light brownish gray mottles above a depth of 30 inches. The Fayette soils have a thinner A1 horizon and a thicker A2 horizon than the Downs Variant. They usually do not have mottles of low chroma above a depth of 30 inches.

Typical pedon of Downs Variant silt loam, 5 to 9 percent slopes, moderately eroded, in a cultivated field; 500 feet north and 100 feet west of the southeast corner of sec 30, T. 80 N., R. 16 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) and dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) dry; cloddy to weak fine granular structure; friable; neutral; abrupt smooth boundary.
B21t—6 to 11 inches; dark brown (10YR 4/3) silty clay loam; very dark grayish brown (10YR 3/2) faces of peds; few fine faint gray silt coatings; weak coarse prismatic structure; friable; thin discontinuous clay films; neutral; gradual smooth boundary.
B22t—11 to 16 inches; brown (10YR 4/3) sity clay loam; few fine faint gray silt coatings; weak medium prismatic structure parting to weak fine subangular blocky; friable; thin discontinuous clay films; slightly acid; clear smooth boundary.
B23t—16 to 21 inches; dark yellowish brown (10YR 4/4) silty clay loam; few fine faint light brownish gray (10YR 6/2) and pale brown (10YR 6/3) and few fine distinct strong brown (7.5YR 5/8) mottles; moderate fine and medium subangular blocky structure; friable; few fine faint gray (10YR 6/1) silt coatings; thin discontinuous clay films; slightly acid; gradual smooth boundary.
B24—21 to 33 inches; light brownish gray (10YR 6/2) and pale brown (10YR 6/3) silty clay loam; common fine distinct strong brown (7.5YR 5/6, 5/8) mottles; weak medium and coarse subangular blocky structure; friable; thin discontinuous gray silt coatings; thin discontinuous clay films; slightly acid; gradual smooth boundary.
B31—33 to 40 inches; grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4) silt loam; common fine distinct strong brown (7.5YR 5/6, 5/8) mottles; weak medium and coarse subangular blocky structure; friable; thin discontinuous gray silt coatings; thin discontinuous clay films; few fine prominent dark oxides; neutral; gradual smooth boundary.
B32—40 to 48 inches; light yellowish brown (2.5Y 6/4) and light brownish gray (2.5Y 6/2) silt loam; common fine distinct strong brown (7.5YR 5/6, 5/8) mottles; weak coarse prismatic structure; friable; thin discontinuous gray silt coatings; thin discontinuous clay films; few fine prominent dark oxides; neutral; gradual smooth boundary.
B33—48 to 60 inches; light brownish gray (2.5Y 6/2) silt loam; common fine distinct strong brown (7.5YR 5/6, 5/8) mottles; weak coarse prismatic structure;

friable; thin discontinuous gray silt coatings; thin discontinuous clay films; few fine prominent dark oxides; neutral.

The solum ranges from 36 to 60 inches or more in thickness. The A1 horizon is from 6 to 9 inches thick. It is very dark brown (10YR 2/2) to very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). Where it is eroded, the A1 horizon is dark grayish brown (10YR 4/2). Generally, the A2 horizon is mixed into the Ap horizon. In undisturbed areas it is dark grayish brown (10YR 4/2) or brown (10YR 5/3). The B2 horizon is dark brown and brown in the upper part and grades to dark yellowish brown that has a chroma as low as 1 or 2 in the lower part. It ranges from 27 to 35 percent clay.

Ely series

The Ely series consists of somewhat poorly drained, moderately permeable soils on slightly concave, low foot slopes and alluvial fans. These soils formed in silty local alluvium and colluvium and under a native vegetation of prairie grasses. Slope ranges from 2 to 5 percent.

Ely soils are similar and adjacent to Colo and Judson soils. Colo soils have a thicker mollic epipedon than Ely soils. They are located on bottom lands near the drainageways. Judson soils are well drained to moderately well drained. They are on foot slopes of uplands.

Typical pedon of Ely silty clay loam, 2 to 5 percent slopes, 945 feet west and 195 feet south of the northeast corner sec. 14, T. 81 N., R. 14 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) light silty clay loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky and granular structure; friable; slightly acid; abrupt smooth boundary.

A12—8 to 15 inches; black (10YR 2/1) light silty clay loam, very dark grayish brown (10YR 3/2) dry; crushes to very dark brown (10YR 2/2); moderate fine granular structure; friable; medium acid; clear smooth boundary.

A3—15 to 22 inches; very dark gray (10YR 3/1) light silty clay loam, dark grayish brown (10YR 4/2) dry, crushes to very dark grayish brown (10YR 3/2); weak fine subangular blocky structure; friable; medium acid; clear smooth boundary.

B1—22 to 30 inches; very dark grayish brown (10YR 3/2) and very dark gray (10YR 3/1) silty clay loam; few fine faint dark yellowish brown (10YR 4/4) mottles; moderate fine subangular blocky structure; friable; few faint discontinuous light colored silt coatings; slightly acid; gradual smooth boundary.

B21—30 to 40 inches; grayish brown (10YR 5/2) silty clay loam, dark gray (10YR 4/1) faces of peds; few fine distinct yellowish brown (10YR 5/4) and strong brown (7.5YR 5/6) and few fine faint dark yellowish brown (10YR 4/4) mottles; weak medium prismatic structure parting to moderate fine subangular blocky; friable; thin discontinuous silt coatings and clay films; some dark colored streaks; slightly acid; gradual smooth boundary.

B22—40 to 47 inches; brown (10YR 5/3) silty clay loam; gray (10YR 5/1) on faces of peds; few fine distinct strong brown (7.5YR 5/6), faint dark yellowish brown (10YR 4/4), and common fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate fine subangular blocky; friable; thin discontinuous silt coatings; some dark colored streaks; few dark colored oxides; slightly acid; gradual smooth boundary.

B23—47 to 51 inches; grayish brown (10YR 5/2) silty clay loam; few fine distinct strong brown (7.5YR 5/6), faint gray (10YR 5/1), and common fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate fine subangular blocky; friable; thin discontinuous silt coatings; few dark colored oxides; neutral; gradual smooth boundary.

B3—51 to 58 inches; grayish brown (10YR 5/2) light silty clay loam; crushes to brown (10YR 5/3); few fine distinct strong brown (7.5YR 5/6), faint gray (10YR 5/1), and common fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; many dark colored oxides; neutral; gradual smooth boundary.

C—58 to 60 inches; grayish brown (10YR 5/2) and gray (10YR 5/1) light silty clay loam; few fine distinct yellowish brown (10YR 5/4) and strong brown (7.5YR 5/6) mottles; massive; friable; many dark colored oxides; neutral.

The solum ranges from about 40 to 60 inches or more in thickness. The soil is 5 to 20 percent very fine sand and fine sand. It is value of 3 or darker to a depth of 24 to 36 inches.

The A horizon is black (10YR 2/1), very dark brown (10YR 2/2), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). In places the A horizon is silt loam. The B2 horizon is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), or brown (10YR 5/3). In places it has mottles of low chroma. The B2 and B3 horizons are mottled with hue of 7.5YR and 10YR, value of 4 or 5, and chroma of 3 through 8. The B horizon is 30 to 35 percent clay.

Fayette series

The Fayette series consists of well drained, moderately permeable soils on the uplands. These soils formed in loess and under native vegetation of forest. Slopes range from 5 to 18 percent.

Fayette soils are adjacent to Downs, Atterberry, Lindley, and Keswick soils. Downs and Atterberry soils

are upslope from the Fayette soil. They have a thicker A1 horizon. Atterberry soils are somewhat poorly drained. Lindley soils formed in glacial till. Keswick soils are fine textured, reddish, and formed partly in glacial till. The upper part of the profile of Keswick soils formed in loess or pedisediment. Lindley and Keswick soils are downslope from the Fayette soil.

Typical pedon of Fayette silt loam, 5 to 9 percent slopes (fig. 9), on north-facing slopes, in timber; 840 feet east and 1,500 feet south of the northwest corner of sec. 9, T. 81 N., R. 13 W.

A1—0 to 3 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine granular structure; very friable; thin patchy light gray (10YR 7/1) silt coatings on peds; few light yellowish brown (10YR 6/4) worm casts; many roots; neutral; clear smooth boundary.

A21—3 to 8 inches; dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak thin platy structure parting to moderate fine granular; very friable; thin patchy light gray (10YR 7/1) silt coatings on peds; few light yellowish brown (10YR 6/4) worm casts; many coatings; slightly acid; clear smooth boundary.

A22—8 to 12 inches; dark grayish brown (10YR 4/2) and brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak thin platy structure parting to moderate fine and medium subangular blocky structure; very friable; thin patchy light gray (10YR 7/1) silt coatings on peds; many roots; mixing of few to common

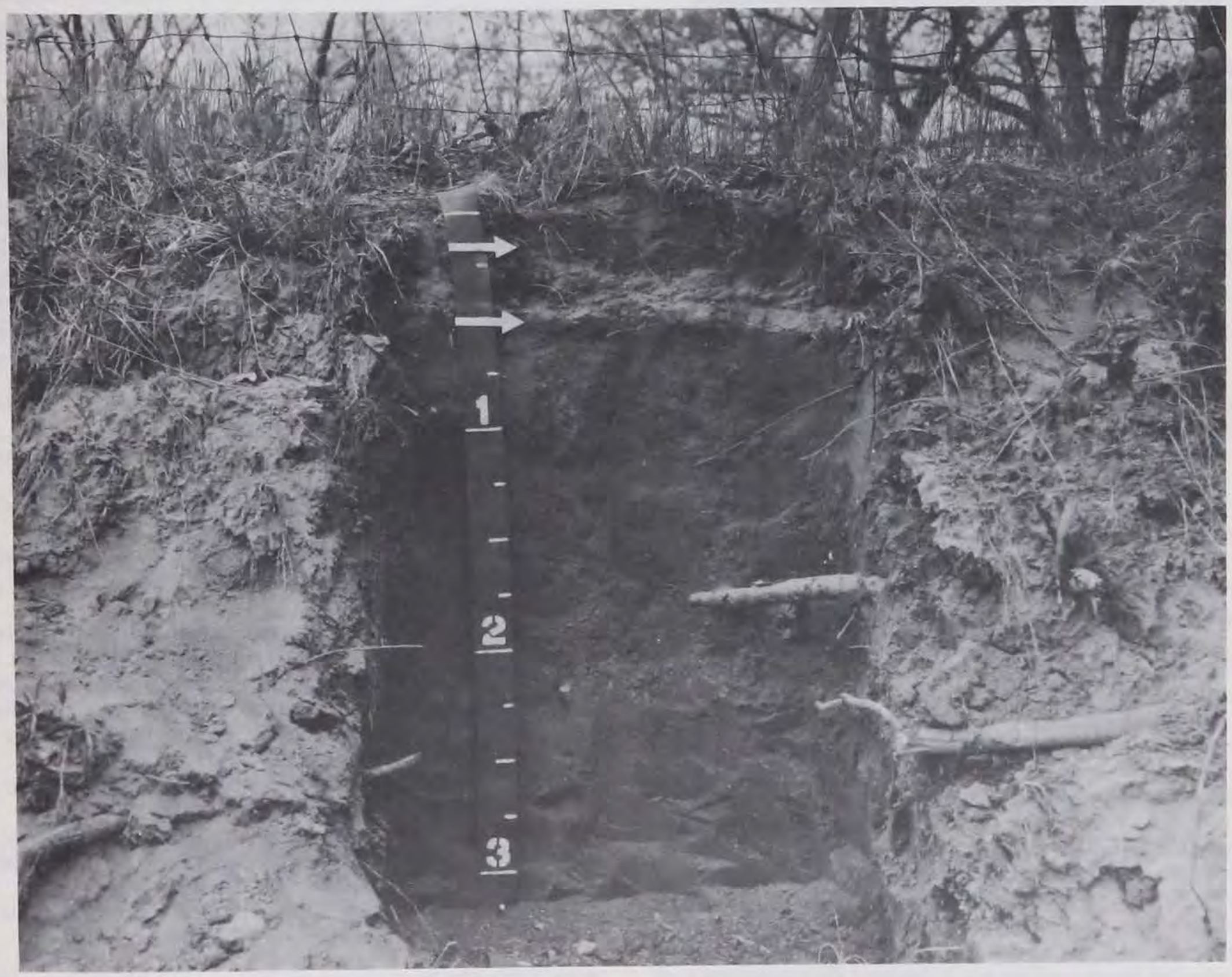


Figure 9.—Fayette silt loam profile that shows soil formation under timber. Note the light color at a depth of 6 inches.

brownish yellow (10YR 6/6) worm casts; medium acid; clear irregular boundary.

B1t—12 to 16 inches; brown (10YR 4/3) and yellowish brown (10YR 5/4) silty clay loam; moderate fine and medium angular and subangular blocky structure; friable; thin patchy light gray (10YR 7/1) silt coatings on peds; few roots; thin discontinuous clay films on faces of peds; strongly acid; gradual smooth boundary.

B21t—16 to 27 inches; brown (10YR 4/3) silty clay loam; moderate fine and medium angular and subangular blocky structure; friable; thin patchy light gray (10YR 7/1) silt coatings on peds; few roots; thin discontinuous clay films on faces of peds; strongly acid; gradual smooth boundary.

B22t—27 to 31 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate medium angular and subangular blocky structure; friable; thin patchy light gray (10YR 7/1) silt coatings on peds; few roots; thin discontinuous clay films on faces of peds; strongly acid; gradual smooth boundary.

B23t—31 to 37 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate medium angular and subangular blocky structure; friable; thin patchy light gray (10YR 7/1) silt coatings on peds; few roots; thin discontinuous clay films on faces of peds; strongly acid; gradual smooth boundary.

B31—37 to 45 inches; yellowish brown (10YR 5/4) silty clay loam; weak coarse prismatic structure parting to moderate medium and coarse angular and subangular blocky; friable; thin patchy light gray (10YR 7/1) silt coatings on peds; thin discontinuous clay films on faces of peds; few dark colored oxides; strongly acid; gradual smooth boundary.

B32—45 to 51 inches; yellowish brown (10YR 5/4) silty clay loam; few fine faint dark brown (10YR 4/3) mottles; weak coarse prismatic structure parting to weak medium and coarse angular and subangular blocky; friable; thin patchy light gray (10YR 7/1) silt coatings on peds; thin discontinuous clay films on faces of peds; few dark colored oxides; strongly acid; gradual smooth boundary.

C—51 to 60 inches; yellowish brown (10YR 5/4) silty clay loam; few fine faint dark brown (10YR 4/3) mottles; massive; some distinct cleavage; friable; thin patchy light gray (10YR 7/1) silt coatings on peds; thin discontinuous clay films on cleavage breaks; few dark colored oxides; medium acid.

The solum typically is 42 to 60 inches thick. The A1 horizon is very dark gray (10YR 3/1), very dark grayish brown (10YR 3/2), or very dark brown (10YR 2/2). When cultivated or eroded, the Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3). In uneroded sites the subhorizon that has the highest clay accumulation, 28 to 35 percent, is between 18 and 24 inches. The lower part of the B horizon and upper part of the C horizon are silt loam or light silty clay loam. Mottles that have hue of 10YR or 2.5Y, value of 5, and chroma of 2 are in the lower part of the B horizon and the C horizon of some pedons.

Gara series

The Gara series consists of moderately well drained to well drained, moderately slowly permeable soils in uplands. These soils formed in glacial till and under a mixed native vegetation of grasses and trees. Slopes range from 9 to 25 percent.

Gara soils are similar to Lindley and Shelby soils and are commonly adjacent to Adair, Armstrong, Killduff, Ladoga, Otley, and Tama soils. The Adair and Armstrong soils are upslope from the Gara soil and formed in a paleosol. Killduff, Ladoga, Otley, and Tama soils formed in loess. Shelby soils do not have an A2 horizon, and Lindley soils have a thinner A1 horizon.

Typical pedon of Gara loam, 14 to 18 percent slopes, on an east-facing, convex slope in pasture and mixed hardwoods; 1,660 feet north and 1,010 feet east of the southwest corner of sec. 31, T. 80 N., R. 16 W.

A1—0 to 5 inches; very dark gray (10YR 3/1) and dark grayish brown (10YR 4/2) loam, gray (10YR 5/1) dry; weak very fine granular structure, friable, slightly acid, clear smooth boundary.

A2—5 to 11 inches; dark grayish brown (10YR 4/2) and brown (10YR 4/3) loam, light brownish gray (10YR 6/2) dry; weak fine platy structure parting to weak very fine granular structure; friable; very dark grayish brown (10YR 3/2) coatings on peds; medium acid; clear smooth boundary.

B21t—11 to 17 inches; brown (10YR 4/3) clay loam; moderate fine subangular blocky structure; firm; dark brown (10YR 3/3) coatings on peds; thin discontinuous clay films; few small pebbles; medium acid; gradual smooth boundary.

B22t—17 to 23 inches; dark yellowish brown (10YR 4/4) clay loam; moderate fine subangular blocky structure; firm; thin discontinuous silt coatings; thin discontinuous clay films; medium acid, gradual smooth boundary.

B23t—23 to 31 inches; yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/4) clay loam, weak medium prismatic structure parting to weak medium subangular blocky structure; firm; thin discontinuous silt coatings; thin discontinuous clay films; strongly acid, gradual smooth boundary.

B31—31 to 43 inches; yellowish brown (10YR 5/4 and 5/6) clay loam; dark yellowish brown (10YR 4/4) coatings on peds; few medium faint grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; thin discontinuous silt coatings and clay films on faces of peds; medium acid, gradual smooth boundary.

B32—43 to 50 inches; mottled grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4 or 5/6) light clay

loam, weak coarse prismatic structure parting to weak medium subangular blocky; firm; mildly alkaline.

C—50 to 60 inches; mottled grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4 or 5/6) light clay loam, massive; firm; many fine calcium carbonate concretions; mildly alkaline.

The solum is typically 40 to 55 inches thick but ranges from 36 to 60 inches or more in thickness. It has a few pebbles and stones throughout.

In most places the Ap horizon is usually a mixture of very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2). The A2 horizon is light brownish gray (10YR 6/2) and grayish brown (10YR 5/2) when dry. The B2t horizon is 16 to 34 inches thick. It has an average clay content of 32 to 35 percent.

Garwin series

The Garwin series consists of poorly drained, moderately permeable soils at level, usually slightly concave heads of drainageways. These soils are in uplands. They formed in loess about 8 feet thick. Native vegetation was tall prairie grasses and sedges. Slopes range from 0 to 2 percent.

Garwin soils are adjacent and similar to Muscatine and Tama soils. Muscatine soils are somewhat poorly drained, and Tama soils are well drained.

Typical pedon of Garwin silty clay loam, 0 to 2 percent slopes, in a cultivated field; 2,040 feet west and 1,280 feet north of the southeast corner of sec 33, T. 81 N., R. 16 W.

Ap—0 to 8 inches; black (N 2/0) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; medium acid; gradual smooth boundary.

A12—8 to 13 inches; black (N 2/0) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; medium acid; gradual smooth boundary.

A3—13 to 18 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; black (10YR 2/1) faces on peds; moderate fine granular structure; friable; medium acid; gradual smooth boundary.

B1g—18 to 24 inches; very dark gray (10YR 3/1) silty clay loam; few fine distinct yellowish brown (10YR 5/4) mottles; moderate fine subangular blocky structure parting to moderate fine granular; friable; thin discontinuous clay films; slightly acid; gradual smooth boundary.

B21g—24 to 30 inches; dark gray (5Y 4/1) silty clay loam; few fine distinct yellowish brown (10YR 5/4) mottles; moderate fine subangular blocky structure; friable; thick continuous clay films; slightly acid; gradual smooth boundary.

B22g—30 to 36 inches; dark gray (5Y 4/1) silty clay loam; few fine distinct yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; friable; thin continuous clay films; few fine black oxides; slightly acid; gradual smooth boundary.

B31g—36 to 48 inches; gray (5Y 5/1) silty clay loam; common medium distinct yellowish brown (10YR 5/6) and prominent strong brown (7.5YR 5/6) mottles; weak medium prismatic structure; friable; thin continuous clay films on prism faces; few fine black oxides; slightly acid; gradual smooth boundary.

B32g—48 to 54 inches; olive gray (5Y 5/2) silty clay loam; common medium distinct yellowish brown (10YR 5/6) and prominent strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure; friable; thin continuous clay films on tongues; few fine black oxides; slightly acid; gradual smooth boundary.

C—54 to 60 inches; light olive gray (5Y 6/2) silt loam; common medium distinct yellowish brown (10YR 5/6) and prominent strong brown (7.5Y 5/6) mottles; massive; friable; common fine black oxides; slightly acid.

The solum ranges from 40 to 60 inches in thickness. The A horizon is black (10YR 2/1 or N 2/0) to very dark gray (10YR 3/1). It is 27 to 37 percent clay. The B2g horizon has hue of 5Y and 2.5Y, value of 3 through 5, and chroma of 1 or 2. This horizon has many to few mottles that have hue of 2.5Y and 7.5YR, values of 4 through 6, and chroma of 4 through 8. It is 30 to 35 percent clay. The 10- to 40-inch control section averages between 27 and 35 percent clay. The C horizon is deoxidized and leached loess. The matrix has hue of 5Y or 2.5Y, value of 4 through 6, and chroma of 1 or 2.

Givin series

The Givin series consists of somewhat poorly drained, moderately slowly permeable soil. These soils are on summits of interfluves that form the heads of drainageways. Givin soils formed in loess. Native vegetation was deciduous trees and tall prairie grasses. Slopes range from 0 to 2 percent.

Givin soils are similar to Atterberry soils and adjacent to Ladoga and Mahaska soils. Atterberry soils have less clay in the B horizon than the Givin soil. They are in similar positions on the landscape and are in the north part of the county. Ladoga soils are brown, have chroma of 3 or 4, and are free of mottles in the upper part of the B horizon. They are on side slopes and usually surround the Givin soils. Mahaska soils have a thicker A1 horizon but do not have an A2 horizon. They are on the nearly level interfluves.

Typical pedon of Givin silt loam, 0 to 2 percent slopes; 1,650 feet east and 100 feet north of the southwest corner of sec. 14, T. 79 N., R. 16 W.

Ap—0 to 7 inches; black (10YR 2/1) silt loam mixed with some grayish brown (10YR 5/2), grayish brown (10YR 5/2) dry; weak fine granular structure; friable;

abundant roots; worm holes; medium acid; abrupt smooth boundary.

A2—7 to 11 inches; very dark grayish brown (10YR 3/2) and very dark gray (10YR 3/1) silt loam and thin layers of grayish brown (10YR 5/2), dark grayish brown (10YR 4/2) and thin strata of light brownish gray (10YR 6/2) and light gray (10YR 7/2) dry; weak thin platy structure parting to weak fine granular; abundant roots and worm holes; medium acid; clear smooth boundary.

B1—11 to 16 inches; dark grayish brown (10YR 4/2) heavy silt loam; weak fine subangular blocky structure; friable; common fine roots and pin holes; thin discontinuous clay films and grayish brown (10YR 5/2) silt coatings; medium acid; gradual smooth boundary.

B21t—16 to 22 inches; brown (10YR 4/3) silty clay loam; moderate fine subangular and angular blocky structure; friable; fine roots and pin holes; grayish brown (10YR 5/2) silt coatings and thin discontinuous dark grayish brown (10YR 4/2) clay films; few fine distinct dark colored oxides; strongly acid; gradual smooth boundary.

B22t—22 to 30 inches; dark grayish brown (10YR 4/2) silty clay loam; brown (10YR 5/3) kneaded; few fine distinct yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular and angular blocky; firm; grayish brown (10YR 5/2) silt coatings on faces of peds; thin discontinuous clay films; few fine distinct dark colored oxides; strongly acid; gradual smooth boundary.

B23t—30 to 37 inches; grayish brown (10YR 5/2) and brown (10YR 5/3) silty clay loam; common fine distinct yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular and angular blocky; firm; light gray (10YR 7/2) silt coatings; thin discontinuous dark grayish brown (10YR 4/2) clay films; few fine dark colored oxides; strongly acid, gradual smooth boundary.

B24t—37 to 46 inches; grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) silty clay loam; common fine distinct and prominent strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure parting to moderate medium and coarse subangular and angular blocky; friable; thin discontinuous dark grayish brown (10YR 4/2) clay films; light gray (10YR 7/2) silt coatings; common fine dark colored oxides; medium acid; clear smooth boundary.

B31—46 to 51 inches; mottled light brownish gray (10YR 6/2), yellowish brown (10YR 5/6), and strong brown (7.5YR 5/6) silty clay loam; weak coarse prismatic structure parting to moderate medium and coarse subangular and angular blocky; friable; thin discontinuous light gray (10YR 7/2) silt coatings and clay films; medium acid; clear smooth boundary.

B32—51 to 60 inches; mottled grayish brown (10YR 5/2), yellowish brown (10YR 5/6), and strong brown (7.5YR 5/6) silty clay loam; weak coarse prismatic structure; friable; thin discontinuous light gray (10YR 7/2) silt coatings and dark grayish brown (10YR 4/2) clay films; common fine distinct dark oxides; medium acid.

The solum ranges from 40 to 60 inches or more in thickness. The A1 horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The unplowed A1 horizon is 6 to 10 inches thick. Where it is plowed, the Ap horizon has value of 3 to the base of the horizon. The A horizon is 18 to 26 percent clay. The A2 horizon is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2). It has some darker color from coatings on horizontal faces or from peds from the A1 horizon. The mottled B2t horizon is commonly dark grayish brown (10YR 4/2) but ranges in hue from 10YR to 2.5Y. Value is 4 or 5, and chroma is 3 or 2. The grayer colors are more common in the lower part of the B horizon. The content of clay in the B2t horizon is 36 to 42 percent. When present, the C horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 2. The C horizon is more than 27 percent to less than 35 percent clay.

Hedrick series

The Hedrick series consists of moderately well drained, moderately permeable soils that formed in gray loess and under a cover of a mixed, native vegetation of grasses and trees. These soils are on short, convex to plane side slopes of nearly level stable divides. They are more commonly at the heads of drainageways. The soils are in uplands. Slopes range from 5 to 14 percent.

Hedrick soils are similar to Givin, Ladoga, and Nira soils. Hedrick soils are the intergrade member of a biosequence that includes the Nira series. The Givin soils are upslope and the Ladoga soils are downslope from the Hedrick soil.

Typical pedon of Hedrick silty clay loam, 9 to 14 percent slopes, moderately eroded, in a plowed alfalfa field; 1,200 feet south and 70 feet east from the northwestern corner of sec. 17, T. 79 N., R. 13 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) silty clay loam, grayish brown (10YR 5/2) dry; moderate fine and medium granular and subangular blocky structure; friable; common fibrous roots; few fine light gray and gray silt coatings; slightly acid; abrupt smooth boundary.

B21t—7 to 11 inches; brown (10YR 4/3) silty clay loam; moderate medium and fine angular and subangular blocky structure; friable; common fibrous roots; few fine discontinuous gray silt coatings; thin discontinuous dark grayish brown clay films; slightly acid; clear smooth boundary.

B22t—11 to 17 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate medium and fine angular

and subangular blocky structure; friable; thin discontinuous silt coatings and clay films; few very dark gray worm casts; medium acid; gradual smooth boundary.

B23t—17 to 23 inches; mottled brown (10YR 5/3) and yellowish brown (10YR 5/4 or 5/6) silty clay loam; few fine distinct strong brown (7.5YR 5/6) and few fine faint grayish brown (10YR 5/2) mottles; moderate fine angular and subangular blocky structure; friable; thin discontinuous silt coatings and clay films; medium acid; gradual smooth boundary.

B24—23 to 30 inches; mottled grayish brown (10YR 5/2), brown (10YR 5/3), and yellowish brown (10YR 5/6) silty clay loam; few fine distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; thin discontinuous silt coatings and clay films; few dark oxides; medium acid; gradual smooth boundary.

B31—30 to 40 inches; mottled light brownish gray (10YR 6/2), yellowish brown (10YR 5/8), strong brown (7.5YR 5/6), and brown (7.5YR 5/4) silty clay loam; weak coarse prismatic structure; friable; thin discontinuous gray silt coatings; few dark oxides; medium acid; diffuse smooth boundary.

B32—40 to 50 inches; mottled light brownish gray (10YR 6/2), yellowish brown (10YR 5/8), brown (7.5YR 5/4), and strong brown (7.5YR 5/6) silty clay loam; weak coarse prismatic structure; friable; thin discontinuous gray silt coatings; few dark oxides; slightly acid; diffuse smooth boundary.

C—50 to 60 inches; mottled light brownish gray (10YR 6/2), yellowish brown (10YR 5/6, 5/8), and strong brown (7.5YR 5/6) silty clay loam; massive; friable; few dark oxides and organic flows in root channels; slightly acid.

The solum is 3 to 5 feet thick. It is free of carbonates. It has gray mottles at a minimum depth of 12 to 20 inches.

The A horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) silty clay loam. In places the surface layer is silt loam. An A2 horizon is usually mixed into the A1 horizon by plowing. The A2 horizon is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2). The B2 horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4 in the upper part and hue of 10YR through 5Y, value of 5 or 6, and chroma of 2 through 8 in the lower part. The B2t horizon is from 32 to 37 percent clay. The maximum content of clay ranges in depth from 8 to 20 inches. The gray colors and iron segregations are relict features in the lower part of the B horizon.

Judson series

The Judson series consists of well drained to moderately well drained, moderately permeable soils formed in local, silty alluvium. These soils are on plane or slightly concave foot slopes and alluvial fans. The natural vegetation was tall prairie grasses. The slopes range from 2 to 9 percent.

Judson soils are similar to Ely soils and are associated with Otley and Tama soils in uplands. Ely soils are more yellow in hue and have a lower chroma. Mottles are common in the B horizon. Otley and Tama soils have a thinner A horizon than the Judson soil and a more strongly expressed B horizon.

Typical pedon of Judson silty clay loam, 5 to 9 percent slopes, in a field of alfalfa; 2,500 feet west and 575 feet north of the southeast corner of sec. 21, T. 78 N, R. 16 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) light silty clay loam, dark grayish brown (10YR 4/2) dry; very dark grayish brown (10YR 3/2) kneaded; weak fine subangular blocky and granular structure; friable; slightly acid; abrupt smooth boundary.

A12—9 to 16 inches; very dark gray (10YR 3/1) light silty clay loam, dark grayish brown (10YR 4/2) dry, very dark gray (10YR 3/1) kneaded; weak fine subangular blocky and granular structure; friable; slightly acid; gradual smooth boundary.

A13—16 to 23 inches; very dark gray (10YR 3/1) light silty clay loam, dark grayish brown (10YR 4/2) dry, very dark grayish brown (10YR 3/2) kneaded; weak very fine subangular blocky structure; friable; neutral; gradual smooth boundary.

A3—23 to 33 inches; very dark grayish brown (10YR 3/2) light silty clay loam; moderate fine subangular blocky structure; friable; thin discontinuous clay films; slightly acid; gradual smooth boundary.

B21—33 to 40 inches; dark brown (10YR 3/3) light silty clay loam; moderate fine subangular blocky structure; friable; very dark grayish brown (10YR 3/2) coatings on peds; thin discontinuous silt coatings and clay films; slightly acid; gradual smooth boundary.

B22—40 to 49 inches; brown (10YR 4/3) silty clay loam; moderate fine and medium subangular blocky structure; friable; dark brown (10YR 3/3) coatings on peds; thin discontinuous silt coatings and clay films; slightly acid; gradual smooth boundary.

B3—49 to 60 inches; yellowish brown (10YR 5/4) silty clay loam; few fine faint grayish brown (10YR 5/2) mottles; weak medium and coarse subangular blocky structure; friable; brown (10YR 4/3) coatings on peds; thin discontinuous silt coatings and clay films; slightly acid.

The solum ranges from 40 to 60 inches or more in thickness. The A horizon is black (10YR 2/1), very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2), or very dark gray (10YR 3/1). The A horizon is from 24 to 32 percent clay. The A horizon ranges from 24 to 36 inches in thickness. The B horizon is dark brown (10YR 3/3) to a depth of 36 inches. As depth increases it has

value of 4 or 5 and chroma of 3 or 4. Ped coatings have value of 3. The B horizon is from 30 to 35 percent clay.

Keswick series

The Keswick series consists of moderately well drained, slowly permeable soils in uplands. These soils formed in a reddish, fine textured paleosol and under a native vegetation of forest. The upper part of the soil profile, above the stone line, formed in loess or pedisediment. At one time this was a buried soil, but it recently has been exposed by erosional processes. Slopes range from 9 to 14 percent.

Keswick soils are similar to Adair and Armstrong soils and commonly adjacent to Clinton, Downs, Fayette, Gara, Ladoga, and Lindley soils. Adair soils do not have the A2 horizon that the Keswick soil has. They have a mollic epipedon. The Armstrong soils have a thicker A1 horizon. The Clinton, Downs, Fayette, and Ladoga soils are upslope from the Keswick soil. They have less clay and less sand and are less red in the B horizon. Gara and Lindley soils are downslope from the Keswick soil. They are less red in hue and contain less clay in the Bt horizon.

Typical pedon of Keswick loam, 9 to 14 percent slopes, moderately eroded (fig. 10), on a north-facing convex slope, in a timbered area; 500 feet east and 980 feet north of the southwest corner of sec. 6, T. 78 N., R. 15 W.

A1—0 to 2 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak fine granular structure; friable; slightly acid; clear smooth boundary.

A21—2 to 5 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; weak thin platy and fine granular structure; friable; thin discontinuous light gray silt coatings on faces of peds; slightly acid; clear smooth boundary.

A22—5 to 9 inches; brown (10YR 4/3) loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; thin discontinuous very dark grayish brown (10YR 3/2) and light gray (10YR 6/1) silt coatings on faces of the peds; medium acid; clear smooth boundary.

B1t—9 to 14 inches; brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; moderate fine subangular and angular blocky structure; friable; strongly acid; clear smooth boundary.

IIB21t—14 to 21 inches; reddish brown (5YR 4/4) and brown (7.5YR 5/2) heavy clay loam; few fine prominent red (2.5YR 4/6) mottles; moderate fine subangular blocky structure; firm; thin continuous clay films on faces of peds; stone line at top of horizon: strongly acid; clear smooth boundary.

IIB22t—21 to 24 inches; mottled reddish brown (5YR 4/4), yellowish red (5YR 4/6), brown (7.5YR 5/2), and red (2.5YR 4/6) clay loam; moderate fine subangular blocky structure; firm; thin continuous clay films on faces of peds; few black accumulations

Figure 10.—A profile of Keswick loam formed mostly in Late Sangamon paleosol. The lower part of the profile below a depth of 2 feet is glacial till.

(oxides); very strongly acid; gradual smooth boundary.
IIB23t—24 to 30 inches; mottled yellowish brown (10YR 5/6 or 5/8) and gray (10YR 6/1) clay loam; common fine prominent reddish brown (5YR 4/4) mottles; moderate fine subangular blocky structure; firm; thin discontinuous clay films on faces of peds; few black accumulations (oxides); very strongly acid; gradual smooth boundary.
IIB24t—30 to 46 inches; mottled yellowish brown (10YR 5/6 or 5/8) and gray (10YR 6/1) clay loam; few fine prominent reddish brown (5YR 4/4) mottles; weak medium subangular blocky structure; firm; thin discontinuous clay films on faces of peds; strongly acid; gradual smooth boundary.
IIB3—46 to 60 inches; mottled yellowish brown (10YR 5/6 and 5/8) and an increasing amount of gray (10YR 6/1) light clay loam; few fine prominent reddish brown (5YR 4/4) mottles; weak medium and fine subangular blocky structure; firm; strongly acid.

The solum ranges from 42 inches to 60 inches or more in thickness. A stone line is in the lower part of the A horizon or the upper part of the B horizon. The A1 horizon is very dark brown (10YR 2/2), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). When eroded, the Ap horizon commonly is dark grayish brown (10YR 4/2). The A1 and A2 horizons are typically loam, but silt loam is in the range. The B2t horizon is firm heavy clay loam or clay that is 30 to 48 percent clay.

Killduff series

The Killduff series consists of well drained and moderately well drained, moderately permeable soils formed in loess. These soils are on short, convex to plane side slopes, in coves at the heads of drainageways, and at the tops of lowered interfluves. They are in the uplands. The natural vegetation is tall prairie grasses. Slopes range from 5 to 14 percent.

Killduff soils are similar to the Downs and Tama soils. Downs and Tama soils have an argillic horizon and do not have grayish mottles above a depth of 30 inches. Downs soils have an A2 horizon. Tama soils have a mollic epipedon.

Typical pedon of Killduff silty clay loam, 5 to 9 percent slopes, in a cultivated field; 2,015 feet east and 160 feet south of the northwest corner of sec. 30, T. 81 N., R. 15 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, very dark grayish brown (10YR 3/2) dry, very dark brown (10YR 2/2) crushed; weak medium subangular blocky structure and weak fine granular structure; friable; neutral; abrupt smooth boundary.
A12—7 to 9 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry, very dark grayish brown (10YR 3/2) crushed; moderate very fine subangular blocky structure and moderate fine granular structure; friable; slightly acid; gradual smooth boundary.
B1—9 to 14 inches; brown (10YR 4/3) silty clay loam, brown (10YR 4/3) crushed; dark brown (10YR 3/3) and very dark grayish brown (10YR 3/2) faces of peds; moderate very fine subangular blocky structure and moderate fine granular structure; friable; slightly acid; gradual smooth boundary.
B21t—14 to 20 inches; brown (10YR 4/3) silty clay loam; dark brown (10YR 3/3) faces of peds; moderate very fine subangular blocky structure; friable; few thin discontinuous clay films; slightly acid; gradual smooth boundary.
B22t—20 to 25 inches; brown (10YR 4/3) light silty clay loam; few fine distinct grayish brown (2.5Y 5/2) mottles and few fine faint yellowish brown (10YR 5/6) mottles; weak very fine subangular blocky structure; friable; few thin discontinuous clay films; few dark soft accumulations (oxides); slightly acid; gradual smooth boundary.
B23—25 to 35 inches; dark yellowish brown (10YR 4/4) light silty clay loam; many fine distinct grayish brown (2.5Y 5/2) and common fine distinct strong brown (7.5YR 5/6) mottles; weak fine and very fine subangular blocky structure; friable; few fine dark concretions and soft accumulations (oxides); slightly acid; gradual smooth boundary.
B3—35 to 46 inches; mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/4) heavy silt loam; many fine distinct strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; few fine dark concretions and soft accumulations (oxides); slightly acid; gradual smooth boundary.
C—46 to 60 inches; mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/4) silt loam; many fine distinct strong brown (7.5YR 5/6) mottles; massive; some vertical cleavage; friable; few fine dark concretions and soft accumulations (oxides); neutral.

The solum ranges from 32 to 55 inches in thickness. The A horizon is black (10YR 2/1), very dark brown (10YR 2/2), or very dark gray (10YR 3/1). The A horizon is less than 10 inches thick. It is from 28 to 33 percent clay. The upper part of the B horizon ranges from brown (10YR 4/3) to yellowish brown (10YR 5/4). The control section is 27 to 33 percent clay. The gray colors are relict.

Koszta series

The Koszta series consists of somewhat poorly drained, moderately permeable soils on low benches or high second bottoms along streams. These soils are normally above flood level. They formed in silty alluvium and under a mixed native vegetation of grasses and trees. Slopes range from 0 to 2 percent.

Koszta soils are similar to Nevin and Vesser soils and are commonly adjacent to Colo, Wiota, and Zook soils. Nevin soils have a mollic epipedon. Vesser soils have a thicker A1 horizon and a thicker A2 horizon and a somewhat browner B horizon than the Koszta soil. Colo and Zook soils have value of 3 to a depth of 36 inches or more. Zook soils contain more clay than the Koszta soil. Wiota soils have a thicker A1 horizon but do not have an A2 horizon. They also have higher chroma and no mottles in the upper part of the B horizon.

Typical pedon of Koszta silt loam, 0 to 2 percent slopes, 300 feet south and 575 feet west of the northeastern corner of sec. 16, T. 81 N., R. 13 W.

Ap—0 to 10 inches; very dark brown (10YR 2/2) silt loam; cloddy and weak fine subangular blocky structure; friable; common roots; thin lenses of light brownish gray (10YR 6/2) dry and dark grayish brown (10YR 4/2) moist; neutral; abrupt smooth boundary.

A2—10 to 15 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; moderate thin platy structure parting to weak fine granular; friable; common roots; medium acid; clear smooth boundary.

B1—15 to 24 inches; dark grayish brown (10YR 4/2) light silty clay loam, light brownish gray (10YR 6/2) dry; common fine distinct reddish brown (5YR 4/3) and yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; friable; occasional roots; thin discontinuous grayish brown (10YR 5/2) silt coatings; medium acid; gradual smooth boundary.

B21t—24 to 30 inches; dark grayish brown (2.5Y 4/2) light silty clay loam; few fine faint grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) and few fine distinct dark brown (7.5YR 4/3) and yellowish brown (10YR 5/6) mottles; weak fine prismatic structure parting to moderate fine subangular blocky; friable; occasional roots; many fine tubular pores; thin discontinuous grayish brown (10YR 5/2) silt coatings; thin discontinuous clay films on prism faces; few fine hard black oxides; slightly acid; gradual smooth boundary.

B22t—30 to 40 inches; mottled gray (2.5Y 5/0 and 2.5Y 6/0), and yellowish brown (10YR 5/6) silty clay loam; few fine distinct very dusky red (2.5YR 2/2), dusky red (2.5YR 3/2), reddish yellow (7.5YR 7/6), and strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; many fine tubular pores; thin discontinuous grayish brown (10YR 5/2) silt coatings; thin discontinuous clay films on prism faces; few fine hard black oxides; medium acid; gradual smooth boundary.

B3t—40 to 52 inches; mottled gray (5Y 6/1) and yellowish brown (10YR 5/6) silty clay loam; weak medium prismatic structure parting to moderate medium subangular blocky; firm; thin discontinuous grayish brown (10YR 5/2) silt coatings; few thin discontinuous clay films; few fine soft brown and common fine hard black oxides; slightly acid; gradual smooth boundary.

C—52 to 60 inches; mottled gray (5Y 6/1) and yellowish brown (10YR 5/6) silty clay loam; massive with vertical cleavage; firm; many dark gray vertical clay flows; few thin discontinuous grayish brown (10YR 5/2) clay films; many medium soft brown and common medium hard black oxides; slightly acid.

The solum is typically 40 inches or more thick, but it ranges from 36 to 60 inches in thickness. The A1 or Ap horizon is black (10YR 2/1), very dark brown (10YR 2/2), or very dark gray (10YR 3/1). The A2 horizon is typically dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2). The B horizon centers on dark grayish brown (10YR 4/2) and is mottled with grayish brown (2.5Y 5/2), gray (5Y 5/1), light gray (5Y 6/1), olive gray (5Y 5/2), and yellowish brown (10YR 5/4, 5/6, or 5/8). The B2 horizon is between 28 and 35 percent clay.

Ladoga series

Ladoga series consists of moderately well drained, moderately slowly permeable soils formed in loess and under a native vegetation of deciduous trees and tall prairie grasses. These soils are in uplands. Slopes range from 2 to 14 percent.

Ladoga soils are similar to Hedrick, Clinton, and Otley soils. Hedrick soils have lower chroma in the lower part of the B2 horizon and have relict gleyed colors above a depth of 36 inches. Ladoga soils have a thicker, dark A1 horizon than the Clinton soil and have a thinner A1 horizon than the Otley soil. Otley soils do not have an A2 horizon.

Typical pedon of Ladoga silt loam, 2 to 5 percent slopes, in pasture; 1,980 feet east and 1,320 feet south of the northwest corner of sec. 16, T. 78 N., R. 16 W.

A1—0 to 8 inches; black (10YR 2/1) silt loam, gray (10YR 5/1) and grayish brown (10YR 5/2) dry, very dark gray (10YR 3/1) kneaded; weak fine granular structure; friable; thin discontinuous silt coatings on faces of peds; few worm casts of grayish brown (10YR 5/2); medium acid; clear smooth boundary.

A2—8 to 11 inches; dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) silt loam, light brownish gray (10YR 6/2) and light gray (10YR 7/2) dry; weak thin platy structure parting to weak fine granular and subangular blocky; friable; thin discontinuous light gray silt coatings on faces of peds; very dark gray (10YR 3/1) coatings on faces of peds in the upper 1 inch; medium acid; abrupt smooth boundary.

B1t—11 to 17 inches; brown (10YR 4/3) silty clay loam, light brownish gray (10YR 6/2) and some light gray (10YR 7/2) dry, dark brown (10YR 3/3) kneaded;

moderate fine and medium angular and subangular structure; friable; very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) coatings on ped faces; thin discontinuous silt coatings and clay films; medium acid; gradual smooth boundary.

B21t—17 to 21 inches; brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; moderate fine and medium angular and subangular blocky structure; friable; dark grayish brown (10YR 4/2) coatings on faces of peds; thin discontinuous silt coatings and clay films; medium acid; gradual smooth boundary.

B22t—21 to 27 inches; brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; few fine distinct yellowish brown (10YR 5/4, 5/6) mottles; moderate medium angular and subangular blocky structure; firm; dark grayish brown (10YR 4/2) coatings on faces of peds; thin discontinuous grayish brown (10YR 5/2) silt coatings; thin discontinuous clay films; strongly acid; gradual smooth boundary.

B23t—27 to 32 inches; brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; common fine distinct yellowish brown (10YR 5/4) and light yellowish brown (10YR 6/4) mottles; moderate medium angular and subangular blocky structure; firm; thin discontinuous grayish brown silt coatings; thin discontinuous clay films; few dark colored streaks and oxides; strongly acid; gradual smooth boundary.

B24t—32 to 39 inches; brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) and light yellowish brown (10YR 6/4) dry; common fine faint olive gray (5Y 5/2) and common fine distinct yellowish brown (10YR 5/4, 5/6) and light yellowish brown (10YR 6/4) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; thin discontinuous dark grayish brown silt coatings; thin discontinuous clay films; few dark colored streaks and oxides; medium acid; gradual smooth boundary.

B3—39 to 50 inches; brown (10YR 5/3) silty clay loam, pale brown (10YR 6/3) dry; few fine distinct yellowish brown (10YR 5/4) and light yellowish brown (10YR 6/4) and common fine faint grayish brown (10YR 5/2) mottles; weak medium and coarse prismatic structure parting to weak medium subangular blocky; friable; thin discontinuous light gray silt coatings; thin discontinuous clay films; few dark colored oxides; medium acid; gradual smooth boundary.

C—50 to 60 inches; grayish brown (10YR 5/2) and brown (10YR 5/3) silty clay loam, light gray (10YR 7/2) and very pale brown (10YR 7/3) dry; common fine distinct yellowish brown (10YR 5/4, 5/6) and light yellowish brown (10YR 6/4) mottles; massive; friable; few light gray silt coatings; few fine dark colored bodies (oxides); medium acid.

The solum ranges from 36 to 60 inches or more in thickness. The A1 horizon is black (10YR 2/1) or very dark grayish brown (10YR 3/2). It is 6 to 10 inches thick. The A2 horizon is 2 to 6 inches thick. The B2 horizon is brown (10YR 4/3) or dark yellowish brown (10YR 4/4). It is 36 to 42 percent clay. Th C horizon is commonly brown (10YR 5/3) and yellowish brown (10YR 5/4) and is mottled with gray. It is silty clay loam; however, in some places it is silt loam. Olive grays below a depth of 36 inches are not excluded from the Ladoga series.

Lamoni series

Lamoni series consists of somewhat poorly drained, slowly permeable or very slowly permeable soils formed in partially truncated, exhumed clayey paleosols. These soils are on convex side slopes of nearly level, stable divides. These divides form valleys. The native vegetation is tall prairie grasses. The slopes range from 9 to 18 percent.

Lamoni soils are similar to the Adair, Clarinda, and Shelby soils. Adair soils have a more reddish subsoil than the Lamoni soils. Clarinda soils contain fewer pebbles and stones and have a thicker and more clayey subsoil than Lamoni soils. The subsoil of the Shelby soils is less gray and contains less clay than that of the Lamoni soils. Clarinda soils are at the heads of drainageways, Lamoni soils are along the drainageways but are at nearly the same elevation as the Clarinda soil, and the Adair soils are in a similar position but are farther along the drainageway.

Typical pedon of an uneroded Lamoni silty clay loam from an area of Lamoni silty clay loam, 14 to 18 percent slopes, moderately eroded, in permanent pasture; 150 feet east and 300 feet south of the northwest corner of sec. 36, T. 79 N., R. 15 W.

A1—0 to 5 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak fine granular; friable; slightly acid; gradual smooth boundary.

A3—5 to 10 inches, black (10YR 2/1) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate very fine and fine subangular blocky structure; friable; medium acid; clear smooth boundary.

IIB1—10 to 14 inches; dark grayish brown (10YR 4/2) and brown (10YR 4/3) light clay; very dark gray (10YR 3/1) faces of peds; few fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; moderate very fine and fine subangular blocky structure; firm; medium acid; gradual smooth boundary.

IIB21t—14 to 20 inches, dark grayish brown (10YR 4/2) clay, brown (10YR 4/3) kneaded; common fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; moderate fine subangular blocky structure; firm; medium acid; thin discontinuous silt coatings; thin discontinuous clay films; medium acid; gradual smooth boundary.

IIB22t—20 to 26 inches; grayish brown (2.5Y 5/2) clay, olive brown (2.5Y 4/4) kneaded; common fine

distinct yellowish brown (10YR 5/4 and 5/6) mottles; moderate fine subangular blocky structure; firm; thin discontinuous silt coatings; thick continuous clay films; medium acid; gradual smooth boundary.

IIB31—26 to 34 inches; grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/4 and 5/6) heavy clay loam, dark grayish brown (10YR 4/2) kneaded; moderate coarse prismatic structure parting to weak medium subangular blocky; firm; few small pebbles; slightly acid; gradual smooth boundary.

IIB32—34 to 50 inches; yellowish brown (10YR 5/4 and 5/6) clay loam; common fine distinct grayish brown (2.5Y 5/2) mottles; moderate coarse prismatic structure parting to weak medium subangular blocky; firm; few small pebbles; neutral; gradual smooth boundary.

IIC—50 to 60 inches; mottled yellowish brown (10YR 5/6), grayish brown (2.5Y 5/2), and strong brown (7.5YR 5/6) light clay loam; massive; firm; few small pebbles; neutral.

The solum ranges from 48 to 60 inches in thickness. The A horizon normally is silty clay loam, but it ranges to clay loam. The A1 horizon or the Ap horizon is black (10YR 2/1) very dark gray (10YR 3/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2). The upper part of the B horizon has hue of 10YR or 2.5Y, value of 4, and chroma of 2. Mottles are of higher chroma. The lower part of the B horizon is mottled and has hue of 10YR to 5Y, value of 5 or 6, and chroma 2 through 6. Yellowish brown and strong brown mottles are common throughout the B2 horizon. Hues redder than 10YR are restricted to mottles and oxides. The B2 horizon is 40 to 50 percent clay.

Lawson series

The Lawson series consists of somewhat poorly drained, moderately permeable soils on the bottom lands. These soils formed in very dark brown and black silty alluvium and under a native vegetation of prairie grasses. Slopes range from 0 to 2 percent.

Lawson soils are similar to Colo and Ely soils. Colo soils have a mollic epipedon that is thicker than 36 inches. Ely soils have a cambic horizon immediately below the mollic epipedon that has chroma of 2.

Typical pedon of Lawson silt loam, 0 to 2 percent slopes, in a cultivated field, on the bottom land; 1,500 feet east and 2,300 feet south of the northwest corner of sec. 5, T. 78 N., R. 13 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) silt loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; neutral; gradual smooth boundary.

A12—8 to 24 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; neutral; gradual smooth boundary.

A13—24 to 30 inches; black (10YR 2/1) silt loam; moderate fine subangular blocky structure; friable; neutral; clear smooth boundary.

C1—30 to 36 inches; very dark gray (10YR 3/1) silt loam; moderate fine and medium subangular blocky structure; friable; neutral; gradual smooth boundary.

C2—36 to 42 inches; very dark grayish brown (10YR 3/2) silty clay loam; few fine faint yellowish brown (10YR 5/6) mottles; moderate fine and medium subangular blocky structure; thin discontinuous silt coatings on faces of peds; neutral; gradual smooth boundary.

C3—42 to 52 inches; very dark grayish brown (10YR 3/2) silty clay loam; few fine faint yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure; friable; thin discontinuous silt coatings on faces of peds; neutral; clear smooth boundary.

C4g—52 to 60 inches; dark grayish brown (10YR 4/2) silty clay loam; few fine prominent yellowish brown (10YR 5/6) mottles; neutral.

The mollic epipedon ranges from 24 to 36 inches in thickness. The 40-inch control section is between 18 and 28 percent clay. The A horizon is black (10YR 2/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2). In some places it is very dark gray (10YR 3/1) in the lower part. The C horizon has hue of 10YR or 2.5Y; value of 3 through 6; and chroma of 1, 2, or 3. Distinct or prominent mottles generally are below the mollic epipedon.

Lindley series

The Lindley series consists of well drained and moderately well drained, moderately slowly permeable soils on sides of valleys and narrowly dissected interfluves. These soils formed in glacial till that is clay loam and under a cover of deciduous hardwoods, mostly oak and hickory. Slopes range from 9 to 40 percent.

Lindley soils are similar to and associated with Gara soils. They are commonly adjacent to Clinton, Downs, Fayette, and Keswick soils. Gara soils are in similar positions on the landscape and have thicker, dark surface horizons. Clinton, Downs, and Fayette soils are upslope from Lindley soils and are formed in loess. Keswick soils are more than 35 percent clay in the upper 20 inches of the argillic horizon. The argillic horizon has hue as red as 5YR in the upper part.

Typical pedon of Lindley loam, 18 to 25 percent slopes, in trees; 520 feet east and 1,080 feet north of the southwest corner of sec. 6, T. 78 N., R. 25 W.

A1—0 to 2 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) and light brownish gray (10YR 6/2) dry; moderate fine granular structure; friable; abundant fibrous roots; few discontinuous gray (10YR 5/1) silt coatings; medium acid; abrupt smooth boundary.

A21—2 to 5 inches; dark grayish brown (10YR 4/2) and brown (10YR 5/3) loam, gray (10YR 5/1) and light gray (10YR 7/2) dry; weak thin platy structure parting to moderate fine granular; friable; abundant fibrous roots; few discontinuous gray (10YR 6/1) silt coatings; some worm casts of very dark gray and dark gray; medium acid; clear smooth boundary.

A22—5 to 9 inches; brown (10YR 5/3) loam, pale brown (10YR 6/3) and light brownish gray (10YR 6/2) dry; weak medium platy structure parting to moderate fine granular; friable; abundant fibrous roots; few discontinuous gray (10YR 6/1) silt coatings; some worm casts of very dark gray and dark gray; medium acid; clear smooth boundary.

B1t—9 to 13 inches; yellowish brown (10YR 5/6) clay loam; moderate fine and medium angular and subangular blocky structure; firm; thin discontinuous clay films and gray (10YR 5/1, 6/1) silt coatings; medium acid; gradual smooth boundary.

B21t—13 to 19 inches; yellowish brown (10YR 5/6) clay loam; few fine distinct strong brown (7.5YR 5/6) mottles; moderate fine angular and subangular blocky structure; firm; few gray (10YR 5/1 or 6/1) silt coatings on faces of peds; thin discontinuous clay films; strongly acid; gradual smooth boundary.

B22t—19 to 25 inches; yellowish brown (10YR 5/6) clay loam; few fine distinct strong brown (7.5YR 5/6) and common fine distinct light brownish gray (10YR 6/2) mottles; moderate fine angular and subangular blocky structure; firm; few discontinuous gray (10YR 5/1, 6/1) silt coatings on faces of peds; thick continuous clay films; strongly acid; clear smooth boundary.

B23t—25 to 36 inches; yellowish brown (10YR 5/6) clay loam; common fine distinct light brownish gray (10YR 6/2) mottles; moderate fine angular and subangular blocky structure; firm; few discontinuous gray silt coatings on faces of peds; thick continuous clay films; few black oxides; strongly acid; clear smooth boundary.

B24t—36 to 48 inches; mottled yellowish brown (10YR 5/6) and light brownish gray (10YR 6/2) clay loam; moderate fine angular and subangular blocky structure; firm; few discontinuous gray silt coatings on faces of peds; thick continuous clay films; few black oxides; strongly acid; clear smooth boundary.

C—48 to 60 inches; yellowish brown (10YR 5/6) clay loam; common medium distinct light brownish gray (10YR 6/2) mottles; massive; firm; neutral.

The solum ranges from 30 to 50 inches in thickness. Glacial pebbles are mixed throughout the soil.

The A1 horizon has hue of 10YR, value of 3 or 4, and chroma of 1 or 2. It is 1 inch to 4 inches thick. The A2 horizon has hue of 10YR, value of 4 or 5, and chroma of 2 through 5. Typically the A horizon is loam, but in some pedons it is silt loam or light clay loam. The B2 horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 through 6. Chroma is rarely 8. The lower part is light brownish gray (10YR 6/2) to gray (10YR 6/1). Generally the B2t horizon is 32 to 35 percent clay.

Liscomb series

The Liscomb series consists of well drained, moderately permeable soils on the lower parts of convex side slopes. These soils are in uplands. They formed in glacial till or loamy surficial sediment over glacial till. Native vegetation was prairie grasses. Slopes range from 9 to 14 percent.

Liscomb soils, as mapped, do not have a mollic epipedon. The thickness of the A horizon and of the mollic coloring range from 4 to 9 inches, which is outside the defined range for the Liscomb series.

Liscomb soils are similar to Shelby soils and are associated with Dinsdale and Tama soils. Shelby soils do not have the loamy, surficial sediment over the glacial till. Dinsdale and Tama soils formed entirely or partly in loess and are upslope from Liscomb soils.

Typical pedon of Liscomb loam, 9 to 14 percent slopes, moderately eroded, in hay meadow; 670 feet north and 2,225 feet west of the southeast corner of the sec. 8, T. 80 N., R. 14 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) and brown (10YR 4/3) loam, brown (10YR 4/3) dry; weak fine granular structure; friable; very dark gray (10YR 3/1) coatings on peds; slightly acid; clear smooth boundary.

B21—8 to 18 inches; brown (10YR 4/3) loam; weak fine and medium subangular blocky structure; friable; very dark grayish brown (10YR 3/2) and very dark brown (10YR 2/2) coatings on peds; thin discontinuous clay films on the faces of peds; stone line at a depth of 18 inches; slightly acid; clear smooth boundary.

B22—18 to 26 inches; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) sandy clay loam; weak coarse prismatic structure and weak medium subangular blocky; friable; brown (10YR 4/3) coatings on peds; thin discontinuous clay films on faces of peds; slightly acid; gradual smooth boundary.

B23—26 to 33 inches; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) sandy clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure; friable; dark yellowish brown (10YR 4/4) and brown (10YR 4/3) coatings on peds; thin discontinuous clay films on faces of peds; slightly acid; gradual smooth boundary.

B31—33 to 40 inches; yellowish brown (10YR 5/4) sandy clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure; friable; dark yellowish brown (10YR 4/4) coatings on peds; thin discontinuous clay films on tongues; slightly acid; gradual smooth boundary.

B32—40 to 46 inches; yellowish brown (10YR 5/6) heavy sandy loam; common fine faint yellowish brown (10YR 5/8) mottles; weak very coarse prismatic structure; dark yellowish brown (10YR 4/4) coatings on peds; thin discontinuous clay films on tongues; slightly acid; gradual smooth boundary.
C1—46 to 52 inches; yellowish brown (10YR 5/4, 5/6) sandy clay loam; massive; friable; thin discontinuous clay films on faces of vertical cleavage; few dark colored root channels; few threads of lime at a depth of 46 inches; neutral; gradual smooth boundary.
C2—52 to 60 inches; yellowish brown (10YR 5/4, 5/6) sandy clay loam; massive; firm; few threads of disseminated lime; neutral.

The solum ranges from 37 to 54 inches in thickness. It is usually the same as depth to calcium carbonates. The Ap horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2). Some brown (10YR 4/3) is mixed into the Ap horizon where it is eroded. The Ap horizon is 30 to 45 percent sand. The B horizon ranges from loam to sandy clay loam and has thin subhorizons of sandy loam. The B horizon usually is less than 27 percent clay and is 44 to 55 percent sand.

Mahaska series

The Mahaska series consists of somewhat poorly drained soils on moderately wide summits of interfluves. These soils have moderate permeability. They have formed in loess and under a cover of native vegetation of tall prairie grasses. Slopes range from 1 to 3 percent.

Mahaska soils are similar to Muscatine and are adjacent to Nira, Otley, and Taintor soils. Muscatine soils have less clay in the B2 horizon. Mahaska soils form a drainage sequence with the poorly drained Taintor and moderately well drained Otley soils. Nira soils have a lower B/A clay ratio, are browner in the upper part of the B horizon, and have a lower clay content than the Mahaska soils.

Typical pedon of Mahaska silty clay loam, 1 to 3 percent slopes, on a slightly convex slope, in a field of soybeans; 350 feet south and 1,585 feet west from the northeast corner of sec. 7, T. 78 N., R. 14 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry, black (10YR 2/1) and very dark gray (10YR 3/1) kneaded; moderate fine angular and subangular blocky structure; friable; common fibrous roots; few worm holes and worm casts; slightly acid; abrupt smooth boundary.
A12—7 to 13 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry, very dark gray (10YR 3/1) kneaded; occasional fibrous roots; few worm holes and worm casts; moderate fine subangular blocky and granular structure; friable; medium acid; clear smooth boundary.
A3—13 to 20 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) kneaded; moderate fine subangular blocky structure; friable; occasional fibrous roots; medium acid; gradual smooth boundary.
B1—20 to 25 inches; dark grayish brown (2.5Y 4/2) heavy silty clay loam, very dark grayish brown (2.5Y 3/2) and dark grayish brown (2.5Y 4/2) kneaded; weak medium prismatic structure parting to moderate fine subangular blocky; friable; very dark gray (10YR 3/1) coatings on peds; strongly acid; gradual smooth boundary.
B21t—25 to 31 inches; grayish brown (2.5Y 5/2) silty clay loam, grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4) kneaded; common fine distinct yellowish brown (10YR 5/8) mottles; weak medium prismatic structure parting to moderate fine subangular blocky; firm; dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) coatings on peds; strongly acid; gradual smooth boundary.
B22t—31 to 40 inches; grayish brown (2.5Y 5/2) heavy silty clay loam; common fine distinct yellowish brown (10YR 5/6 and 5/8) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; dark grayish brown (10YR 4/2) coatings on peds; medium acid; gradual smooth boundary.
B31t—40 to 53 inches; light olive gray (5Y 6/2) silty clay loam; common fine distinct yellowish brown (10YR 5/6 and 5/8) mottles; weak coarse prismatic structure; firm; gray (5Y 5/2) coatings on peds; black (5Y 2/1) and dark reddish brown (5YR 3/3) oxides; medium acid; gradual smooth boundary.
B32t—53 to 60 inches; olive gray (5Y 5/2) silty clay loam; common fine distinct yellowish brown (10YR 5/6) and common fine distinct strong yellowish brown (10YR 5/8) mottles; weak coarse prismatic structure; firm; black (5Y 2/1) and dark reddish brown (5YR 3/3) oxides; medium acid.

The solum is typically about 60 inches thick. It ranges from 4 to 5 feet or more in thickness.

The A horizon is black (10YR 2/1), very dark brown (10YR 2/2), or very dark gray (10YR 3/1). It ranges from heavy silt loam to medium silty clay loam that is 10 to 20 inches thick. The B horizon is very dark grayish brown (10YR or 2.5Y 3/2), dark grayish brown (2.5 4/2), or olive brown (2.5Y 4/4) in the upper part. The middle part grades into a matrix color that is hue of 2.5Y or 10YR, value of 4 or 5, and chroma of 2 or 3. The lower part has hue of 2.5Y or 5Y; value of 4, 5, or 6; and chroma of 2 or 3. The B horizon is 36 to 42 percent clay.

Muscatine series

The Muscatine series consists of somewhat poorly drained, moderately permeable soils on moderately wide, loess-covered divides. These soils formed in loess and

under a native vegetation of prairie grasses. Slopes range from 0 to 2 percent.

Muscatine soils are commonly adjacent to Garwin and Tama soils. Garwin soils are poorly drained and have a grayer subsoil than the Muscatine soil. Tama soils have a brown B horizon and are well drained.

Typical pedon of Muscatine silty clay loam, 0 to 2 percent slopes, in a cultivated field; 1,390 feet north and 1,580 feet east of the southwest corner of sec. 33, T. 81 N., R. 16 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium granular structure; friable; slightly acid; gradual smooth boundary.

A12—7 to 17 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine and medium granular structure; friable; medium acid; gradual smooth boundary.

B1—17 to 23 inches; dark grayish brown (10YR 4/2) silty clay loam; moderate very fine and fine subangular blocky structure; friable; few black (10YR 2/1) coatings on faces of peds; medium acid; gradual smooth boundary.

B21t—23 to 29 inches; dark grayish brown (10YR 4/2) silty clay loam; few fine faint grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) and few fine distinct strong brown (7.5YR 5/6 and 5/8) mottles; moderate fine and medium subangular blocky structure; friable; thin discontinuous clay films; medium acid; gradual smooth boundary.

B22t—29 to 35 inches; dark grayish brown (10YR 4/2) silty clay loam; few fine faint grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) and common fine distinct strong brown (7.5YR 5/6 and 5/8) mottles; moderate medium subangular blocky structure; friable; thin discontinuous clay films; slightly acid; gradual smooth boundary.

B3—35 to 41 inches; dark grayish brown (10YR 4/2) silty clay loam; common fine faint grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) and common fine distinct strong brown (7.5YR 5/6 and 5/8) mottles; weak coarse prismatic structure; friable; medium acid; gradual smooth boundary.

C1—41 to 53 inches; grayish brown (2.5Y 5/2) silt loam; few fine distinct strong brown (7.5YR 5/6 and 5/8) mottles; massive; friable; few dark minerals; slightly acid; gradual smooth boundary.

C2—53 to 60 inches; grayish brown (2.5Y 5/2) heavy silt loam; few fine distinct strong brown (7.5YR 5/6 and 5/8) mottles; massive; friable; neutral.

The solum ranges from 40 to 60 inches in thickness. The A horizon is black (10YR 2/1) or very dark brown (10YR 2/2). Typically it ranges from 14 to 20 inches in thickness. The B horizon is dark grayish brown (10YR or 2.5Y 4/2) in the upper part and ranges to value of 5 or 6 and chroma of 2 or 4 in the lower part. The B2t horizon is 27 to 35 percent clay. The lower part of the B3 horizon and the C horizon typically have hue of 10YR to 2.5Y, value of 5 or 6, and chroma of 2.

Mystic series

The Mystic series consists of moderately well drained and somewhat poorly drained soils on extended, stepped interfluves or remnants of old foot slopes associated with river valleys. The permeability of these soils is slow. These soils are Late Sangamon paleosols. They formed in alluvium and under a cover of native vegetation that is mixed prairie grasses and deciduous trees. Slopes range from 9 to 14 percent.

Mystic soils are similar to Armstrong, Adair, Gara, Keswick, Lindley, and Shelby soils. Armstrong, Adair, and Keswick soils contain a pebble band in the upper part of the solum and do not have stratification in the lower part of the B and C horizons. In all parts of the B horizon, Gara, Lindley, and Shelby soils do not have a hue as red as or redder than 7.5YR in either the matrix or the distinct or prominent mottles. All of these soils are upslope from the Mystic soil.

Typical pedon of Mystic clay loam, 9 to 14 percent slopes, moderately eroded, on a south-facing, convex slope, in field of alfalfa; 1,400 feet east and 560 feet south of the northwest corner of sec. 27, T. 80 N., R. 15 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) and brown (10YR 3/3) clay loam, brown (10YR 5/3) dry, dark brown (10YR 3/3) kneaded; few fine distinct reddish yellow (7.5YR 6/8) mottles; weak fine subangular blocky structure parting to weak fine granular; firm; thin discontinuous pale brown silt coatings; medium acid; abrupt smooth boundary.

B1—6 to 9 inches; dark brown (10YR 3/3) and brown (10YR 4/3) clay loam, brown (10YR 5/3) dry, dark brown (10YR 3/3) kneaded; common fine prominent yellowish red (5YR 4/6 and 4/8) mottles; moderate fine subangular blocky structure; firm; pale brown (10YR 6/3, dry) silt coatings on faces of peds; thin discontinuous clay films on faces of peds; strongly acid; gradual smooth boundary.

B21t—9 to 14 inches; brown (10YR 4/3 and 5/3) light clay, brown (10YR 5/3) and pale brown (10YR 6/3) dry, dark grayish brown (10YR 4/2) kneaded; common fine prominent yellowish red (5YR 4/6 and 4/8) and common fine faint grayish brown (2.5Y 5/2) mottles; moderate fine subangular blocky structure; firm; some very dark grayish brown (10YR 3/2) coatings on faces of peds; some light gray (10YR 7/2) silt coatings on faces of peds dry; thin discontinuous clay films on faces of peds; strongly acid; gradual smooth boundary.

B22t—14 to 19 inches; dark grayish brown (2.5Y 4/2) and grayish brown (2.5Y 5/2) light clay, dark grayish brown (10YR 4/2) kneaded; strong fine subangular

blocky structure; firm; very dark grayish brown (10YR 3/2) coatings on faces of peds; light gray (10YR 7/2) silt coatings on faces of peds dry; thin discontinuous clay films on faces of peds; strongly acid; gradual smooth boundary.

B23t—19 to 24 inches; grayish brown (2.5Y 5/2) clay loam; common medium prominent strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure parting to weak medium subangular blocky; firm; dark grayish brown (10YR 4/2) coatings on faces of peds; light gray (10YR 7/2) silt coatings dry; thin discontinuous clay films on faces of peds; few dark soft bodies (oxides); strongly acid; gradual smooth boundary.

B24t—24 to 29 inches; grayish brown (2.5Y 5/2) light clay; few fine prominent strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; light gray silt coatings on faces of peds; thin discontinuous clay films; very strongly acid; gradual smooth boundary.

B31—29 to 36 inches; grayish brown (2.5Y 5/2) loam, light gray (2.5Y 7/2) dry; few fine distinct strong brown (7.5YR 5/6) mottles; weak medium prismatic structure; friable; thin discontinuous silt coatings and clay films on faces of peds; strongly acid; gradual smooth boundary.

B32—36 to 42 inches; grayish brown (2.5Y 5/2) loam; few fine distinct yellowish brown (10YR 5/4) mottles; weak medium prismatic structure; friable; thin discontinuous silt coatings and clay films on faces of peds; very strongly acid; clear smooth boundary.

B33—42 to 51 inches; mottled grayish brown (2.5Y 5/2), light brownish gray (2.5Y 6/2), yellowish brown (10YR 5/6), and strong brown (7.5YR 5/6) loam, light gray (2.5Y 7/2) dry; weak coarse prismatic structure; friable; common fine distinct black streaks of oxides; medium acid; clear smooth boundary.

C—51 to 60 inches; light brownish gray (2.5Y 6/2) loam, light gray (2.5Y 7/2) dry; few fine prominent strong brown (7.5YR 5/6) and few fine distinct yellowish brown (10YR 5/4) mottles; massive; friable; few dark oxides; slightly acid.

The solum ranges from 4 to 5 feet or more in thickness. The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) silt loam, loam, or light clay loam. In some eroded pedons the A2 horizon has been incorporated with the Ap horizon. When present, the A2 horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 or 3. It is silt loam or loam. The B2t horizon is variable over short distances but has the maximum clay content characteristic of heavy clay loam, clay, or silty clay. It has hue of 2.5YR to 2.5Y, value of 3 through 5, and chroma of 2 through 4. Part of the B horizon has hue of 7.5YR or redder in the matrix or the mottles. Moderately coarse textured to fine textured sediments that are high in quartz are common in the part of the B horizon that is below a depth of 3 feet. These lower, stratified sediments are an irregular mixture of contrasting textures and colors.

Nevin series

The Nevin series consists of somewhat poorly drained, moderately permeable soils on low benches or on high second bottoms along streams. These soils formed in silty alluvium and under a native vegetation of prairie grass. Slopes range from 0 to 2 percent.

Nevin soils are similar to Bremer, Ely, Koszta, and Wiota soils and are commonly adjacent to Bremer and Wiota soils. Bremer soils are wetter and higher in clay than the Nevins soil is. They also have more colors of low chroma. Bremer soils are on the lower and more level parts of the low benches or high second bottoms. Ely soils do not have an argillic horizon. Koszta soils do not have a mollic epipedon, but do have an A2 horizon. There is a greater contrast in amount of clay between the A and B horizons of the Koszta soils than between the A and B horizons of the Nevin soil. The Koszta soils are more acid than the Nevin soil. Wiota soils have a brown B horizon that does not have mottles of low chroma, except for a few in the lower part. Wiota soils are on slightly convex rises or short slopes of the benches.

Typical pedon of Nevin silty clay loam, 0 to 2 percent slopes, in a field of soybean stubble; 2,450 feet north and 300 feet east of the southwest corner of sec. 21, T. 78 N., R. 16 W.

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

A12—8 to 14 inches; black (10YR 2/1) light silty clay loam, dark gray (10YR 4/1) dry, very dark gray (10YR 3/1) kneaded; moderate fine granular structure and weak fine subangular blocky structure; friable; occasional fibrous roots; medium acid; gradual smooth boundary.

A3—14 to 19 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) dry, very dark grayish brown (10YR 3/2) kneaded; weak fine subangular blocky structure; friable; occasional fibrous roots; medium acid; gradual smooth boundary.

B1—19 to 25 inches; dark grayish brown (10YR 4/2) silty clay loam; weak very fine subangular blocky structure; friable; very dark gray (10YR 3/1) coatings on peds; occasional fibrous roots; occasional worm holes and very dark grayish brown (10YR 3/2) worm coatings; slightly acid; gradual smooth boundary.

B21t—25 to 33 inches; dark grayish brown (10YR 4/2) silty clay loam; few fine distinct yellowish brown (10YR 5/4) mottles; weak medium prismatic structure parting to weak fine subangular blocky; friable; occasional fibrous coatings; numerous worm

holes and very dark grayish brown (10YR 3/2) worm coatings; slightly acid; gradual smooth boundary.
B22t—33 to 39 inches; dark grayish brown (10YR 4/2) silty clay loam; few fine faint grayish brown (10YR 5/2) and common fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to weak fine subangular blocky; friable; occasional worm holes and very dark grayish brown (10YR 3/2) worm casts; slightly acid; gradual smooth boundary.
B31t—39 to 44 inches; grayish brown (10YR 5/2) silty clay loam; common fine faint dark grayish brown (10YR 4/2) and common fine distinct grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to weak fine subangular blocky; firm; occasional worm holes and very dark grayish brown (10YR 3/2) worm casts; slightly acid; gradual smooth boundary.
B32t—44 to 51 inches; grayish brown (10YR 5/2) silty clay loam; common fine faint brown (10YR 4/3) and common fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; occasional worm holes and very dark grayish brown (10YR 3/2) worm casts; small firm very dusky red (10R 2/2) and dusky red (10R 3/2) oxides; neutral; gradual smooth boundary.
C—51 to 60 inches; grayish brown (10YR 5/2) silty clay loam; common fine faint brown (10YR 4/3) and common fine distinct yellowish brown (10YR 5/8) mottles; massive; firm; occasional worm holes and very dark grayish brown (10YR 3/2) worm casts; small firm very dusky red (10R 2/2) and dusky red (10R 3/2) oxides; neutral.

The solum ranges from 36 to 60 inches in thickness. The A horizon ranges from 18 to 30 inches in thickness. It is silty clay loam or silt loam that is 24 to 32 percent clay. The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, chroma of 2 or 3. Mottles have higher chroma. The B horizon is from 32 to 36 percent clay. The C horizon is silt loam or silty clay loam.

Nira series

The Nira series consists of moderately well drained soils formed in loess and under a cover of native vegetation of tall prairie grasses. These soils are in uplands. They are on convex to plane side slopes of stable divides. They are more common in heads of drainageways. These soils have moderate permeability. Slopes range from 5 to 14 percent.

This pedon of Nira silty clay loam, as mapped, does not have a mollic epipedon. The thickness of the mollic colors is typically about 4 to 9 inches, which is outside the defined range of the Nira series.

Nira soils are similar to Hedrick, Mahaska, and Otley soils. Hedrick soils have an A2 horizon. Mahaska soils have a thicker A horizon and Otley soils do not have the gray in the matrix within a depth of 3 feet. Generally, Mahaska soils are upslope from the Nira soil and Otley soils are downslope.

Typical pedon of Nira silty clay loam, 5 to 9 percent slope, moderately eroded, in a cultivated field; 1,350 feet south and 1,485 feet east of the northwest corner of sec. 6, T. 78 N., R. 15 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) and very dark grayish brown silty clay loam (10YR 3/2), dark grayish brown (10YR 4/2) dry, very dark grayish brown (10YR 3/2) kneaded mixed with some brown (10YR 4/3); weak medium subangular blocky structure parting to weak fine granular; friable; neutral; abrupt smooth boundary.
B21t—7 to 15 inches; brown (10YR 4/3) silty clay loam, brown (10YR 5/3) dry, brown (10YR 4/3) kneaded; dark brown (10YR 3/3) faces of peds; few fine faint grayish brown (2.5Y 5/2) mottles; moderate fine subangular blocky structure; firm; thin discontinuous clay films; slightly acid; gradual smooth boundary.
B22t—15 to 22 inches; brown (10YR 4/3) silty clay loam, brown (10YR 4/3) kneaded; dark brown (10YR 3/3) faces of peds; common moderate faint grayish brown (2.5Y 5/2) and few fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; thin discontinuous clay films; medium acid; clear smooth boundary.
B31tg—22 to 29 inches; olive gray (5Y 5/2) and light olive gray (5Y 6/2) silty clay loam; grayish brown (2.5Y 5/2) faces of peds; fine moderate distinct strong brown (7.5YR 5/6) and few fine distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to weak medium subangular blocky; friable; few fine dark concretions; medium acid; gradual smooth boundary.
B32tg—29 to 37 inches; olive gray (5Y 5/2) and light olive gray (5Y 6/2) silty clay loam; grayish brown (2.5Y 5/2) faces of peds; common medium prominent strong brown (7.5YR 5/6) and common fine distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to weak medium subangular blocky; friable; few fine dark concretions; medium acid; gradual smooth boundary.
B33tg—37 to 44 inches; olive gray (5Y 5/2) and light olive gray (5Y 6/2) silty clay loam; many fine distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to weak coarse subangular blocky; friable; few fine dark concretions; very dark grayish brown (10YR 3/2) root channels; slightly acid; gradual smooth boundary.
C—44 to 60 inches; light olive gray (5Y 6/2) silty clay loam; common medium prominent yellowish red (5YR 5/8) and yellowish brown (10YR 5/8) mottles; massive; friable; few fine dark concretions; neutral.

The solum typically is 40 to 50 inches thick but ranges from 30 to 50 inches in thickness. The A horizon ranges from black (10YR 2/1) to very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). It centers on silty clay loam that is 30 to 34 percent clay. Unless eroded, it is usually 10 to 15 inches thick. The B horizon is brown (10YR 4/3) or dark yellowish brown (10YR 4/4) in the upper part. Within a depth of 30 inches or less, the matrix has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 1 or 2. The content of clay in the B horizon is 33 to 35 percent. That in the control section is 28 to 35 percent. The C horizon is silty clay loam or silt loam.

Nodaway series

The Nodaway series consists of moderately well drained, moderately permeable soils. These soils are on alluvial fans along tributary streams and are on flood plains next to the natural stream channel. These flood plains have recently received sediments. Nodaway soils formed in silty alluvium of low sand content and under a native vegetation of prairie grasses. Slopes range from 0 to 2 percent.

Nodaway soils are similar to Ackmore and Lawson soils and are commonly adjacent to Ackmore, Colo, Kennebec, and Zook soils. Ackmore soils have a dark buried soil at a depth of 20 to 36 inches. Colo soils are on flood plains and the lower parts of upland drainageways that have not recently received sediments. In some places the adjacent Colo soils have recently received up to 18 inches of sediments. Lawson soils have a mollic epipedon that is 24 to 36 inches thick. Zook soils commonly are some distance from the main stream channel and are on low and flat parts of first bottoms adjacent to Nodaway soils.

Typical pedon of Nodaway silt loam, 0 to 2 percent slopes (fig. 11), in a field of corn; 200 feet west and 2,440 feet south of the northeast corner of sec. 19, T. 78 N., R. 16 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak thin platy and granular structure; friable; thin light brownish gray (10YR 6/2) lenses of fine and coarse silt; many fibrous roots; neutral; abrupt smooth boundary.

C—7 to 38 inches; stratified very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), and grayish brown (10YR 5/2) silt loam; massive but tends to be platy because of stratification; friable; thin very dark brown (10YR 2/2) silt loam and silty clay loam strata; many fibrous roots; many root channels in lower part of horizon; many worm holes; neutral; abrupt smooth boundary.

IIA1b—38 to 60 inches; black (10YR 2/1) silty clay loam; moderate very fine and fine subangular blocky structure; friable; few fine faint brown (10YR 4/3) iron stains; common to few fibrous roots that decrease with depth; few worm holes; neutral.

Figure 11.—Profile of Nodaway silt loam. The horizontal strata were deposited by flood water.

Nodaway soils are silt loam, or in some places they are light silty clay loam. They have only a few very thin lenses of fine sand or coarser material above a depth of 40 inches. The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). In some pedons a dark, medium and moderately fine textured buried soil is below a depth of 36 inches. The control section is neutral or slightly acid.

Olmitz series

The Olmitz series consists of well drained to moderately well drained soils on foot slopes. These soils formed in loamy materials that washed from adjoining slopes and under native vegetation of prairie grasses. They have moderate permeability. Slopes range from 2 to 9 percent.

Olmitz soils are adjacent to Shelby and Gara soils. These soils have a thinner A horizon and a less friable B horizon than the Olmitz soils.

Typical pedon of Olmitz loam, 2 to 5 percent slopes, on west-facing slope, in soybean stubble; 200 feet south and 1,900 feet west of the northeast corner of sec. 15, T. 79 N., R. 15 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) loam mixed with some black (10YR 2/1), dark

grayish brown (10YR 4/2) dry; moderate fine granular structure; friable; neutral; clear smooth boundary.
A12—7 to 16 inches; very dark brown (10YR 2/2) heavy loam, very dark grayish brown (10YR 3/2) dry; weak very fine and fine subangular blocky structure; friable; occasional fibrous roots; medium acid; gradual smooth boundary.
A13—16 to 22 inches; very dark brown (10YR 2/2) light clay loam, very dark grayish brown (10YR 3/2) dry; moderate very fine and fine subangular blocky structure; friable; occasional fibrous roots; medium acid; gradual smooth boundary.
A3—22 to 30 inches; very dark brown (10YR 2/2) light clay loam, very dark grayish brown (10YR 3/2) dry; moderate fine subangular blocky structure; friable; few fine tubular root channels and pores; medium acid; gradual smooth boundary.
B1—30 to 37 inches; very dark grayish brown (10YR 3/2) light clay loam, dark grayish brown (10YR 4/2) dry; black (10YR 2/1) coatings on peds; weak coarse prismatic structure parting to weak very fine and fine subangular blocky; friable; few fine tubular root channels and pores; medium acid; gradual smooth boundary.
B2—37 to 45 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) and brown (10YR 4/3) dry; weak coarse prismatic structure parting to weak very fine and fine subangular blocky; friable; few fine tubular root channels and pores; few small pebbles; slightly acid; gradual smooth boundary.
B3—45 to 60 inches; dark brown (10YR 3/3) clay loam, brown (10YR 4/3) dry; weak coarse prismatic structure parting to weak medium subangular blocky; friable; very dark grayish brown (10YR 3/2) coatings on peds; few fine tubular root channels and pores; few small pebbles; slightly acid.

The solum is typically 40 inches or more thick and ranges from 36 to 60 inches or more in thickness. The A horizon is black (10YR 2/1) and very dark brown (10YR 2/2). In places of recent deposition, the surface layer is very dark grayish brown (10YR 3/2). The A horizon is 24 to 32 inches thick. It is loam or light clay loam in texture. The B horizon has value of 3 and chroma of 2 or 3. It is 28 to 34 percent clay.

Otley series

The Otley series consists of moderately well drained, moderately permeable soils on convex summits and side slopes of interfluves in uplands and on high benches along streams. These soils formed in loess and under a cover of native vegetation of tall prairie grasses. Slopes range from 2 to 14 percent on summits and side slopes of the uplands and from 2 to 9 percent on the high benches along streams.

Otley soils are similar to and associated with Ladoga, Mahaska, Nira, and Taintor soils. The somewhat poorly drained Mahaska soils and the poorly drained Taintor soils are in a drainage sequence with the Otley soils. Generally, Mahaska and Taintor soils are upslope from Otley soils. Ladoga soils have an A1 horizon that is thinner or lighter colored, or both, than that of the Otley soil. They have an A2 horizon. Nira soils are in similar position on the landscape, but they are mainly in heads of drainageways. Otley soils do not have gray in the matrix within a depth of 36 inches.

Typical pedon of Otley silty clay loam, 2 to 5 percent slopes, in a cultivated field; 2,490 feet east and 700 feet south of the northwest corner of the northwest quarter of sec. 4, T. 78 N., R. 14 W.

Ap—0 to 7 inches; black (10YR 2/1) light silty clay loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to weak fine granular; friable; abundant fibrous roots; neutral; abrupt smooth boundary.
A12—7 to 13 inches; black (10YR 2/1) light silty clay loam, dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) dry, very dark grayish brown (10YR 3/2) kneaded; weak fine subangular blocky structure parting to moderate fine granular; friable; some very dark grayish brown (10YR 3/2) coatings on faces of peds; abundant fibrous roots; slightly acid; gradual smooth boundary.
A3—13 to 17 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) dry, dark grayish brown (10YR 4/2) kneaded; weak fine subangular blocky structure parting to moderate fine granular; friable; many fibrous roots; common worm holes; strongly acid; clear smooth boundary.
B21t—17 to 25 inches; brown (10YR 4/3) silty clay loam; moderate very fine subangular blocky structure; friable; common fibrous roots; common worm holes; few discontinuous clay films; medium acid; gradual smooth boundary.
B22t—25 to 31 inches; yellowish brown (10YR 5/4) silty clay loam, brown (10YR 5/3) kneaded; few fine faint dark grayish brown (10YR 4/2) mottles; moderate very fine and fine subangular blocky structure; friable; few roots; common worm holes; few discontinuous clay films; medium acid; gradual smooth boundary.
B23t—31 to 37 inches; brown (10YR 5/3) silty clay loam; many fine faint grayish brown (2.5Y 5/2) mottles; weak fine and medium subangular blocky structure parting to moderate fine subangular blocky; friable; few roots; thin discontinuous clay films; medium acid; gradual smooth boundary.
B31t—37 to 44 inches; grayish brown (2.5Y 5/2) silty clay loam; weak medium prismatic structure parting to moderate medium subangular blocky; friable; yellowish brown (10YR 5/4) coatings on peds; few

thin discontinuous clay films; medium acid; gradual smooth boundary.

B32t—44 to 54 inches; grayish brown (2.5Y 5/2) silty clay loam; many fine distinct yellowish brown (10YR 5/4 and 5/6) and few fine distinct strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure parting to moderate fine subangular blocky; friable; brown (10YR 5/3) coatings on peds; few thin discontinuous clay films; slightly acid; gradual smooth boundary.

B33t—54 to 60 inches; yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) silty clay loam; common fine distinct dark brown (10YR 3/3) mottles; weak coarse prismatic structure parting to weak coarse subangular blocky; medium acid.

The solum is typically about 60 inches thick and ranges from 48 to 72 inches in thickness. The A horizon ranges from 10 to 20 inches in thickness. It is black (10YR 2/1) to very dark grayish brown (10YR 3/2). It is 28 to 34 percent clay. The B2 horizon ranges from 20 to 30 inches in thickness. The upper part is brown (10YR 4/3 or 5/3), dark yellowish brown (10YR 4/4), or yellowish brown (10YR 5/4). The lower part of the B horizon has hue of 10YR or 2.5Y, value of 4 through 6, and chroma of 2 through 6. In the B horizon, mottles increase in abundance and in contrast with depth. The B2t horizon is 36 to 42 percent clay.

Shelby series

The Shelby series consists of well drained and moderately well drained, moderately slowly permeable soils in uplands. These soils formed in glacial till and under a cover of a native vegetation of prairie grasses. Slopes range from 9 to 40 percent.

Shelby soils are similar to Gara and Lindley soils and commonly adjacent to Adair, Killduff, Otley, and Tama soils. The Adair soils are upslope from Shelby soils and formed in paleosol. Killduff, Otley, and Tama soils formed in loess. Gara and Lindley soils have an A2 horizon that the Shelby soils do not have. All these soils have a thinner A1 horizon.

Typical pedon of Shelby loam, 9 to 14 percent slopes, moderately eroded (fig. 12), on a convex side slope in upland; 330 feet south and 100 feet east of the northwest corner of sec 15, T. 79 N., R. 16 W.

A1—0 to 7 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; slightly acid; clear smooth boundary.

B1—7 to 11 inches; dark brown (10YR 3/3) and dark yellowish brown (10YR 4/4) clay loam, brown (10YR 4/3) and dark yellowish brown (10YR 4/4) dry, very dark grayish brown (10YR 3/2) kneaded; weak fine subangular blocky structure; friable; very dark grayish brown (10YR 3/2) coatings on faces of peds; thin discontinuous clay films on faces of peds; medium acid; clear smooth boundary.

Figure 12.—Profile of Shelby loam. This soil formed in glacial till. Stones and pebbles are common.

B21t—11 to 16 inches; dark yellowish brown (10YR 4/4) clay loam, dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) dry, yellowish brown (10YR 5/4) kneaded; moderate fine subangular blocky structure; firm; dark brown (10YR 3/3) coatings on peds; thin discontinuous clay films; medium acid; gradual smooth boundary.

B22t—16 to 23 inches; yellowish brown (10YR 5/4) clay loam, yellowish brown (10YR 5/4) dry and kneaded; moderate fine subangular blocky structure; firm; brown (10YR 4/3) and dark yellowish brown (10YR 4/4) coatings on peds; thin discontinuous silt coatings and clay films; medium acid; gradual smooth boundary.

B23t—23 to 33 inches; yellowish brown (10YR 5/4) clay loam, yellowish brown (10YR 5/4) and light yellowish brown (10YR 6/4) dry; few fine faint grayish brown (2.5Y 5/2) mottles; weak coarse blocky structure parting to moderate fine and medium subangular blocky; firm; brown (10YR 4/3) and dark yellowish brown (10YR 4/4) coatings on

peds; thin discontinuous silt coatings and clay films; slightly acid; gradual smooth boundary.
B24t—33 to 41 inches; brown (10YR 4/3) clay loam, yellowish brown (10YR 5/4) and light yellowish brown (10YR 6/4) dry; common fine faint grayish brown (2.5Y 5/2) and few fine prominent yellowish red (5YR 5/6) mottles; weak coarse blocky structure parting to weak fine and medium subangular blocky; firm; thin discontinuous clay films; neutral; gradual smooth boundary.
B3t—41 to 52 inches; mottled grayish brown (2.5Y 5/2) and dark yellowish brown (10YR 4/4) clay loam; weak coarse blocky structure parting to weak medium subangular blocky; firm; few small stones and pebbles; many small calcium carbonate soft bodies; few dark oxides; mildly alkaline; gradual smooth boundary.
C1—52 to 60 inches; mottled dark yellowish brown (10YR 4/4), yellowish brown (10YR 5/6), and grayish brown (2.5Y 5/2) clay loam; massive; firm; few stones and pebbles; many small calcium carbonate soft bodies; few dark colored oxides; moderately alkaline.

The solum is generally 40 to 60 inches thick and ranges from 36 to 72 inches in thickness. The A horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2). It is loam or light clay loam. The uneroded A horizon is 10 to 18 inches thick. The B2 horizon ranges from dark brown (10YR 3/3) to yellowish brown (10YR 5/4 and 5/6 or 5/8). It is 12 to 36 inches thick. It is usually slightly acid or neutral. The B3 horizon is medium or light clay loam. The C horizon is light brownish gray (10YR 6/2) or grayish brown (2.5Y 5/2) and is neutral to moderately alkaline.

Sparta series

The Sparta series consists of excessively drained, rapidly permeable soils on uplands, on terraces along streams, and on outwash plains. In some areas the topography is hummocky dunes. These soils formed in sandy alluvium, which is reworked by wind in many places. The native vegetation was grasses. Slopes range from 5 to 18 percent.

Sparta soils are similar to Chelsea soils and are commonly adjacent to Tama, Downs, and Ladoga soils on the uplands and to Nevin and Wiota soils on some stream benches. Chelsea soils do not have a mollic epipedon. Tama, Downs, and Ladoga soils formed in loess. Nevin soils are silty and are lower on the landscape. Wiota soils are also silty.

Typical pedon of Sparta loamy fine sand, 9 to 18 percent slopes, 990 feet north and 1,370 feet east of the southwest corner of sec. 21, T. 78 N., R. 16 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak moderate subangular blocky structure; very friable; slightly acid; clear smooth boundary.
A3—9 to 14 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak coarse subangular blocky structure; very friable; slightly acid; clear wavy boundary.
B21—14 to 23 inches; dark brown (10YR 3/3) loamy fine sand; weak coarse subangular blocky structure; very friable; very dark grayish brown (10YR 3/2) clay bridging; slightly acid; gradual wavy boundary.
B22—23 to 34 inches; brown (10YR 4/3) loamy fine sand; weak coarse subangular blocky structure; very friable to loose; dark brown (10YR 3/3) clay bridging; medium acid; gradual wavy boundary.
C—34 to 60 inches; yellowish brown (10YR 5/4) sand; single grain; loose; dark yellowish brown (10YR 4/4) sandy loam band; medium acid.

The solum ranges from 24 inches to about 40 inches in thickness. The mollic epipedon ranges from 10 to 24 inches in thickness.

The A1 or Ap horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. It is loamy sand or loamy fine sand. The B horizon has hue of 10YR or 7.5YR and value and chroma of 3 through 6. It is sand, fine sand, loamy sand, or loamy fine sand. Reaction is slightly or medium acid.

Sperry series

The Sperry series consists of very poorly drained or poorly drained, slowly permeable soils. These nearly level soils are in slight depressions on broad divides. They are in uplands. The Sperry soils formed in loess and under a native vegetation of tall prairie grasses that are tolerant to wetness. Slopes range from 0 to 1 percent.

The Sperry soils are similar to Givin soils and commonly adjacent to Garwin, Mahaska, Muscatine, and Taintor soils, which are at slightly higher elevations. These soils do not have the A2 horizon that the Sperry soil has. Givin soils have a thinner A1 horizon and less mottling.

Typical pedon of Sperry silt loam, 0 to 1 percent slopes, in a cultivated field; 1,815 feet west and 600 feet south of the northeast corner of the northeast quarter of sec. 8, T. 81 N., R. 16 W.

Ap—0 to 6 inches; black (N 2/0) silt loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.
A12—6 to 11 inches; black (N 2/0) silt loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to weak fine granular; friable; neutral; abrupt smooth boundary.
A2—11 to 18 inches; dark gray (10YR 4/1) and gray (10YR 5/1) silt loam; few fine faint brown (10YR 4/3) mottles; weak thin platy structure; friable; slightly acid; abrupt smooth boundary.

B21tg—18 to 24 inches; dark gray (10YR 4/1) heavy silty clay loam; common fine distinct yellowish brown (10YR 5/4) and strong brown (7.5YR 5/6) mottles; strong fine subangular blocky structure; firm; some very dark gray (10YR 3/1) coatings; thick continuous clay films; slightly acid; gradual smooth boundary.
B22tg—24 to 31 inches; dark gray (10YR 4/1) light silty clay; common fine distinct yellowish brown (10YR 5/4 and 5/6) and prominent dark brown (7.5YR 4/4) mottles; strong fine subangular blocky structure; firm; some very dark gray (10YR 3/1) coatings; slightly acid; gradual smooth boundary.
B23tg—31 to 38 inches; gray (5Y 5/1) light silty clay; common fine distinct yellowish brown (10YR 5/4 or 5/6) and prominent dark brown (7.5YR 4/4) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; some dark gray (10YR 4/1) coatings; slightly acid; gradual smooth boundary.
B3tg—38 to 50 inches; gray (5Y 5/1) and olive gray (5Y 5/2) silty clay loam; common fine distinct yellowish brown (10YR 5/4 and 5/6) and prominent dark brown (7.5YR 4/4) mottles; weak coarse prismatic structure parting to weak medium subangular blocky; friable; few fine dark manganese oxides; slightly acid; gradual smooth boundary.
Cg—50 to 60 inches; gray (5Y 6/1) silty clay loam; common fine and medium distinct yellowish brown (10YR 5/6) and prominent dark brown (7.5YR 4/4) mottles; massive; friable; few fine dark manganese oxides; slightly acid.

The solum ranges from 40 to 60 inches or more in thickness. The A1 horizon is 10 to 12 inches thick. It is black (N 2/0) to very dark gray (10YR 3/1) in color. The A2 horizon is 6 to 8 inches thick. The B2tg horizon ranges from dark gray (10YR 4/1 and 5Y 4/1) to gray (10YR 5/1 and 5Y 5/1). It is 36 to 42 percent clay.

Taintor series

The Taintor Series consists of poorly drained, moderately slowly permeable soils that are level. These soils are usually in slightly concave areas on broad divides. They are in uplands. They formed in loess and under a native vegetation of prairie grasses. Slopes are less than 2 percent.

Taintor soils are similar to and commonly adjacent to Mahaska, Otley, and Sperry soils. Otley and Mahaska soils usually surround the Taintor soil. The very poorly drained Sperry soils are in slight depressions. They have an A2 horizon. The somewhat poorly drained Mahaska soils and the moderately well drained Otley soils are members of the same drainage sequence as the Taintor soil.

Typical pedon of Taintor silty clay loam, 0 to 2 percent slopes, 2,540 feet south and 100 feet east of the northwest corner of sec. 24, T. 78 N., R. 14 W.

Ap—0 to 6 inches; black (N 2/0) silty clay loam, black (10YR 2/1) dry; moderate fine medium granular structure; friable; common fibrous roots; slightly acid; abrupt smooth boundary.
A12—6 to 12 inches; black (N 2/0) silty clay loam, black (10YR 2/1) dry; moderate very fine subangular blocky structure; friable; common fibrous roots; slightly acid; gradual smooth boundary.
A3—12 to 17 inches; black (10YR 2/1) heavy silty clay loam, black (10YR 2/1) dry; common fine faint very dark grayish brown (2.5Y 3/2) mottles inside peds; moderate very fine subangular blocky structure; firm; few dark concretions; medium acid; gradual smooth boundary.
B1t—17 to 22 inches; very dark grayish brown (2.5Y 3/2) light silty clay; black (10YR 2/1) faces of peds; common fine faint very dark grayish brown (2.5Y 3/2) mottles inside peds; few fine faint light olive brown (2.5Y 5/6) mottles; moderate very fine subangular blocky structure; firm; common fibrous roots; medium acid; gradual smooth boundary.
B21tg—22 to 29 inches; olive gray (5Y 5/2) heavy silty clay loam; common fine distinct dark gray (5Y 4/1), light olive brown (2.5Y 5/4), and few fine distinct and prominent yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; firm; common fibrous roots; thin discontinuous clay films; few dark concretions; slightly acid; clear smooth boundary.
B22tg—29 to 34 inches; olive gray (5Y 5/2) silty clay loam; dark gray (5Y 4/1) faces of peds; few fine distinct and prominent yellowish brown (10YR 5/6) mottles; moderate coarse prismatic structure; firm; common fibrous roots; thin discontinuous clay films; few dark concretions; slightly acid; clear smooth boundary.
B31tg—34 to 40 inches; olive gray (5Y 5/2) silty clay loam; common fine faint light olive brown (2.5Y 5/4) and few fine distinct and prominent yellowish brown (10YR 5/6) mottles; moderate coarse prismatic structure; friable; common fibrous roots; thin discontinuous clay films; few dark concretions; neutral; gradual smooth boundary.
B32tg—40 to 47 inches; light olive gray (5Y 6/2) silty clay loam; olive gray (5Y 5/2) faces of peds; common fine prominent yellowish brown (10YR 5/6) mottles; moderate coarse prismatic structure; friable; common fibrous roots; many fine tubular pores; thin discontinuous clay films; few dark concretions; neutral; diffuse smooth boundary.
C—47 to 60 inches; light olive gray (5Y 6/2) silty clay loam; olive gray (5Y 5/2) faces of peds; few fine distinct yellowish brown (10YR 5/6) mottles; massive with some vertical cleavage; friable; few fibrous roots; mildly alkaline.

the solum ranges from 42 to 72 inches in thickness. The A1 horizon is black (N 2/0 or 10YR 2/1) and ranges

from medium to heavy silty clay loam. The B horizon has hue of 10YR through 5Y, value of 4 or 5, and chroma of 1 or 2. The upper 20 inches of the argillic horizon is about 38 to 42 percent clay. The B horizon has mottles that range from 2.5Y and 7.5YR to 10YR in hue; from 4 to 5 in value; and from 4 to 8 chroma. The C horizon is olive gray (5Y 5/2) or light olive gray (5Y 6/2) and is mottled.

Tama series

The Tama series consists of well drained, moderately permeable soils on uplands. These soils formed in loess and under grass vegetation. Slopes range from 0 to 14 percent.

Tama soils are similar to Killduff, Otley, and Wiota soils and are commonly adjacent to Adair, Killduff, Muscatine, and Shelby soils. Killduff soils have a mottled B horizon. Otley soils have more clay in the B horizon than the Tama soils. Wiota soils have a thicker mollic epipedon and have less clay contrast between the B and C horizons. The Adair soil is a paleosol formed in glacial till. Muscatine soils have chroma of 2 and some mottles below the mollic epipedon. Shelby soils are downslope and formed in glacial till.

Typical pedon of Tama silty clay loam, 2 to 5 percent slopes, in a pasture 1,120 feet south and 75 feet west of the northeastern corner of sec. 22, T. 81 N., R. 16 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, very dark grayish brown (10YR 3/2) dry; moderate fine granular structure; friable; neutral; abrupt smooth boundary.

A12—7 to 12 inches; black (10YR 2/1) silty clay loam, very dark grayish brown (10YR 3/2) dry, very dark brown (10YR 2/2) crushed; moderate fine and medium granular structure; friable; neutral; gradual smooth boundary.

A13—12 to 18 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry, very dark grayish brown (10YR 3/2) crushed; moderate fine and medium granular structure; friable; slightly acid; gradual smooth boundary.

B1t—18 to 24 inches; brown (10YR 4/3) and dark brown (10YR 3/3) silty clay loam, dark brown (10YR 3/3) crushed; moderate fine and medium subangular blocky structure; friable; thin discontinuous clay films; slightly acid; gradual smooth boundary.

B21t—24 to 30 inches; brown (10YR 4/3) silty clay loam, brown (10YR 4/3) kneaded; moderate fine and medium subangular blocky structure; friable; thin discontinuous clay films; medium acid; gradual smooth boundary.

B22t—30 to 36 inches; brown (10YR 4/3) and dark yellowish brown (10YR 4/3) silty clay loam; moderate fine and medium subangular blocky structure; friable; thin discontinuous clay films; slightly acid; gradual smooth boundary.

B31—36 to 40 inches; dark yellowish brown (10YR 4/4) silty clay loam; few fine distinct grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; friable; thin discontinuous clay films on prism faces; few fine prominent dark oxides; slightly acid; gradual smooth boundary.

B32—40 to 46 inches; brown (10YR 5/3) silty clay loam; many fine distinct grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; friable; thin discontinuous clay films on faces of prisms; few fine prominent dark oxides; slightly acid; gradual smooth boundary.

C1—46 to 52 inches; brown (10YR 5/3) silty clay loam; many fine distinct grayish brown (10YR 5/2), strong brown (7.5YR 5/6), and brown (7.5YR 5/4) mottles; massive; few fine discontinuous silt coatings; neutral; gradual smooth boundary.

C—52 to 60 inches; yellowish brown (10YR 5/4) silty clay loam; many fine distinct grayish brown (10YR 5/2), brown (7.5YR 5/4), and strong brown (7.5YR 5/6) mottles; massive; friable; few fine discontinuous silt coatings; neutral.

The solum ranges from 42 to 60 inches in thickness. The A1 horizon is black (10YR 2/1) to very dark grayish brown (10YR 3/2) silty clay loam or silt loam. This horizon is 10 to 18 inches thick. The B horizon is brown (10YR 4/3), dark yellowish brown (10YR 4/4), or yellowish brown (10YR 5/4). It is 27 to 35 percent clay.

Tuskeego series

The Tuskeego series consists of poorly drained, very slowly permeable soils that are nearly level to slightly depressional. These soils are on bottom lands. They formed in alluvial sediments and under a cover of native vegetation of prairie grasses and deciduous trees. Slopes range from 0 to 2 percent.

Tuskeego soils are similar to Vesser soils and are associated with Colo and Zook soils, which formed in alluvium. Vesser soils have a thicker A2 horizon than the Tuskeego soil and have moderate permeability. The Colo and Zook soils do not have an A2 horizon.

Typical pedon of Tuskeego silt loam, 0 to 2 percent slopes, in a field of clover hay; located 950 feet west and 1,525 feet south of the northeast corner of sec. 20, T. 78 N., R. 16 W.

Ap—0 to 5 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine granular structure; friable; common roots and pores; neutral; clear smooth boundary.

A12—5 to 8 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; moderate fine granular structure; friable; common roots and pores; thin discontinuous silt coatings; common worm casts; slightly acid; abrupt smooth boundary.

A21—8 to 12 inches; dark gray (10YR 4/1) dark grayish brown (10YR 4/2), and gray (10YR 5/1) silt loam, dark grayish brown (10YR 4/2) kneaded; few fine faint and distinct yellowish brown (10YR 5/4 or 5/6) mottles; moderate thin platy structure; friable; common roots and pores; medium acid; thin silt coatings; clear smooth boundary.
A22—12 to 17 inches; gray (10YR 5/1) and dark grayish brown (10YR 4/2) silt loam, dark grayish brown (10YR 4/2) kneaded; few fine faint and distinct yellowish brown (10YR 5/4 or 5/6) mottles; weak thin platy structure parting to moderate fine and medium subangular blocky; friable; common roots and pores; thin silt coatings; hard dark colored concretions; medium acid; clear smooth boundary.
B1tg—17 to 20 inches; very dark gray (10YR 3/1) and dark grayish brown (10YR 4/2) silty clay; few fine faint and distinct yellowish brown (10YR 5/4, 5/6) mottles; weak thin platy structure parting to moderate fine and medium subangular blocky; firm; thin discontinuous silt coatings and clay films; medium acid; clear smooth boundary.
B21tg—20 to 27 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) kneaded; few fine faint and distinct yellowish brown (10YR 5/4, 5/6) mottles; weak coarse prismatic structure parting to moderate medium angular blocky; firm; thin patchy silt coatings; thick continuous very dark gray (10YR 3/1) clay films; medium acid; clear smooth boundary.
B22tg—27 to 37 inches; dark gray (10YR 4/1) silty clay, grayish brown (10YR 5/2) kneaded; common fine distinct yellowish brown (10YR 5/4 or 5/6) mottles; weak coarse prismatic structure parting to moderate medium and fine subangular blocky; firm; thin patchy silt coatings; thin discontinuous clay films; few black oxides; slightly acid; gradual smooth boundary.
B23tg—37 to 41 inches; gray (10YR 5/1) silty clay, grayish brown (10YR 5/2) kneaded; few fine faint and distinct yellowish brown (10YR 5/4 or 5/6) mottles; weak coarse prismatic structure parting to moderate medium and fine subangular blocky; firm; thin patchy silt coatings; thin discontinuous clay films; few black oxides; slightly acid; gradual smooth boundary.
B3g—41 to 60 inches; gray (10YR 5/1) silty clay loam; few fine faint and distinct yellowish brown (10YR 5/4 or 5/6) mottles; weak coarse prismatic structure parting to medium and fine subangular blocky; firm; thin patchy silt coatings; thin discontinuous clay films; few black oxides; slightly acid.

The solum ranges from 48 to 60 inches or more in thickness. The A1 horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). The A2 horizon ranges from very dark grayish brown (10YR 3/2) to dark grayish brown (10YR 4/2), dark gray (10YR 4/1), or gray (10YR 5/1). The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. In places the value is 3 in the B horizon. The B horizon has a maximum content of 38 to 48 percent clay.

Vesser series

The Vesser series consists of somewhat poorly drained or poorly drained, moderately permeable soils on high bottom lands, on foot slopes, and on fans. These soils formed in silty alluvium and under a native vegetation of grasses. Slopes range from 0 to 2 percent.

Vesser soils are similar to Olmitz and Judson soils and commonly adjacent to Colo and Nodaway soils. Olmitz soils are associated with Vesser soils on the alluvial fans and foot slopes. Olmitz soils have a thicker dark A horizon and are loamy. Judson soils are on the foot slopes and are well drained to moderately well drained. Colo and Nodaway soils are with Vesser soils on the nearly level bottom lands. Colo soils have a thicker mollic epipedon, do not have an A2 horizon, and are poorly drained. Nodaway soils do not have a mollic epipedon.

Typical pedon of Vesser silt loam, 0 to 2 percent slopes, 40 feet south and 1,585 feet west of the northeast corner of sec. 16, T. 81 N., R. 13 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure parting to weak fine granular; friable; neutral; abrupt smooth boundary.
A12—8 to 17 inches; very dark gray (10YR 3/1) heavy silt loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to moderate fine granular; friable; neutral; clear smooth boundary.
A21—17 to 26 inches; dark gray (10YR 4/1) silt loam, gray (10YR 5/1) dry; few fine distinct dark brown (7.5YR 3/2) mottles; weak medium platy structure parting to weak medium subangular blocky; friable; light gray (10YR 7/1) silt and fine sand coatings; common black oxides; slightly acid; gradual smooth boundary.
A22—26 to 32 inches; dark gray (10YR 4/1) silt loam, dark grayish brown (10YR 4/2) rubbed; moderate medium platy structure parting to moderate medium subangular blocky; friable; light gray (10YR 7/1) silt and fine sand coatings; grayish brown (10YR 5/2) clay flows; many worm channels; slightly acid; clear smooth boundary.
B21tg—32 to 36 inches; dark gray (10YR 4/1) and gray (10YR 5/1) light silty clay loam, grayish brown (10YR 5/2) rubbed; few fine faint dark brown (7.5YR 3/2) mottles; moderate medium subangular blocky structure; friable; light gray (10YR 7/1) silt and fine sand coatings; grayish brown (10YR 5/2) clay flows; many worm channels; medium acid; gradual smooth boundary.
B22tg—36 to 42 inches; dark gray (10YR 4/1) and gray (10YR 5/1) silty clay loam, grayish brown (10YR

5/2) rubbed; few fine distinct dark brown (7.5YR 3/2 and 4/4) mottles; moderate fine to medium prismatic structure parting to moderate medium subangular blocky; firm; light gray (10YR 7/1) silt and fine sand coatings; grayish brown (10YR 5/2) clay flows; slightly acid; gradual smooth boundary.

B23tg—42 to 46 inches; dark gray (10YR 4/1) and gray (10YR 5/1) silty clay loam, grayish brown (10YR 5/2) rubbed; few fine distinct dark brown (7.5YR 3/2 and 4/4) mottles; moderate fine to medium prismatic structure parting to moderate medium subangular blocky; firm; light gray (10YR 7/1) silt and fine sand coatings; grayish brown (10YR 5/2) clay flows; common black oxides; slightly acid; gradual smooth boundary.

B3tg—46 to 52 inches; dark gray (10YR 4/1) and gray (10YR 5/1) silty clay loam, grayish brown (10YR 5/2) and brown (10YR 5/3) rubbed; few fine distinct dark brown (7.5YR 3/2 and 4/4) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; light gray (10YR 7/1) silt and fine sand coatings; grayish brown (10YR 5/2) clay flows; common black oxides; slightly acid; gradual smooth boundary.

C—52 to 72 inches; gray (10YR 5/1), grayish brown (10YR 5/2), and light brownish gray (10YR 6/2) silty clay loam; few medium distinct yellowish brown (10YR 5/6) and few fine distinct dark brown (7.5YR 4/4) mottles; massive; firm; very dark grayish brown (10YR 3/2) clay flows in root channels; dark brown (10YR 3/3) soft accumulations; slightly acid.

The solum ranges from 50 to 60 inches or more in thickness. The A1 horizon ranges from 12 to 20 inches in thickness. The A2 horizon is dark gray (10YR 4/1) to very dark grayish brown (10YR 5/2). It has weak to moderate, medium platy structure parting to weak and moderate, medium subangular blocky structure. It commonly ranges from 12 to 20 inches in thickness. The upper 20 inches of the B2tg horizon is between 27 and 35 percent clay. In some pedons horizons that are 40 percent clay are below a depth of 40 inches. The B2tg horizon has hue of 10YR of 2.5Y, value of 3 through 5, and chroma of 1 or 2.

Watkins series

The Watkins series consists of well drained and moderately well drained, moderately permeable soils on low benches or second bottom lands along streams. These soils are normally above flood levels. They formed in silty alluvium and under a cover of native vegetation of deciduous trees and tall prairie grasses. Slopes range from 0 to 2 percent.

Watkins soils are adjacent to and similar to Koszta, Nevin, and Wiota soils. The Koszta soils, which are in somewhat similar positions on the landscape, have lower chroma throughout the B horizon. Nevin and Wiota soils have a mollic epipedon but do not have an A2 horizon. Wiota soils have a higher chroma in the B horizon than Watkins soils.

Typical pedon of Watkins silt loam, 0 to 2 percent slopes, in disturbed bluegrass pasture that has scattered trees; 350 feet south and 1,770 feet west of the northeastern corner of sec. 16, T. 81 N., R. 13 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silt loam, dark grayish brown (10YR 4/2) dry, very dark grayish brown (10YR 3/2) kneaded; weak fine granular structure; friable; slightly acid; clear smooth boundary.

A2—7 to 12 inches; very dark grayish brown (10YR 3/2) and brown (10YR 4/3) silt loam, light brownish gray (10YR 6/2) dry; few fine faint yellowish brown (10YR 5/4, 5/6) mottles; weak thin platy structure parting to weak fine granular; friable; slightly acid; gradual smooth boundary.

B1—12 to 18 inches; brown (10YR 4/3) and dark yellowish brown (10YR 4/4) silty clay loam; few fine faint yellowish brown (10YR 5/4 or 5/6) mottles; moderate fine subangular blocky structure; friable; thin discontinuous silt coatings and clay films; slightly acid; gradual smooth boundary.

B21t—18 to 30 inches; brown (10YR 4/3) silty clay loam; few fine faint yellowish brown (10YR 5/6) mottles; moderate fine and medium subangular blocky structure; firm; thin discontinuous silt coatings and clay films; few dark colored oxides; medium acid; gradual smooth boundary.

B22t—30 to 35 inches; dark yellowish brown (10YR 4/4) silty clay loam; few fine faint yellowish brown (10YR 5/6) mottles; moderate medium angular and subangular blocky structure; firm; nearly continuous silt coatings and clay films; few dark colored oxides; medium acid; gradual smooth boundary.

B23t—35 to 44 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak coarse prismatic structure parting to moderate coarse and medium angular and subangular blocky; firm; nearly continuous light gray silt coatings; very dark grayish brown (10YR 3/2) clay films; few dark colored oxides; medium acid; gradual smooth boundary.

B3—44 to 56 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak coarse prismatic structure; firm; thin discontinuous light gray (10YR 7/2) silt coatings and brown (10YR 4/3) and very dark grayish brown (10YR 3) clay films; medium acid; gradual smooth boundary.

C—56 to 60 inches; brown (10YR 5/3) silty clay loam; few fine distinct strong brown (7.5YR 5/6) mottles; massive; firm; slightly acid.

The solum ranges from 40 to 60 inches in thickness. It is less than 15 percent sand above a depth of 40 inches.

The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). The B horizon, the upper

20 inches of the argillic horizon, is from 30 to 35 percent clay. Stratification is sometimes evident below a depth of 40 inches. Watkins soils are medium or strongly acid in the most acid part of the solum.

Wiota series

The Wiota series consists of well drained and moderately well drained, moderately permeable soils formed in alluvium. These soils are on low terraces along streams. The natural vegetation is tall prairie grasses. Slopes range from 0 to 2 percent.

Wiota soils are associated with and are similar to Bremer and Nevin soils. Bremer soils are poorly drained and finer textured than the Wiota soil. The Nevin soils are somewhat poorly drained and are slightly lower on the landscape. The poorly drained Colo and Zook soils are on nearby flood plains.

Typical pedon of Wiota silty clay loam, 0 to 2 percent slopes, on a slightly convex bench along a stream, in soybean stubble; 1,330 feet west and 1,040 feet south of the northeast corner of sec. 19, T. 78 N., R. 16 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; common roots; many worm holes and casts; medium acid; abrupt smooth boundary.

A12—7 to 15 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to weak fine granular; friable; many worm holes and casts; common roots; medium acid; gradual smooth boundary.

A3—15 to 21 inches; very dark grayish brown (10YR 3/2) silty clay loam mixed with some brown (10YR 4/3), dark grayish brown (10YR 4/2) kneaded; moderate fine subangular blocky structure parting to moderate fine granular; friable; occasional roots; thin discontinuous clay films; medium acid; gradual smooth boundary.

B1t—21 to 28 inches; brown (10YR 4/3) silty clay loam; weak fine subangular blocky structure; friable; thin discontinuous clay films; strongly acid; gradual smooth boundary.

B2t—28 to 39 inches; brown (10YR 4/3) silty clay loam; weak medium subangular blocky structure; friable; thin discontinuous clay films; strongly acid; gradual smooth boundary.

B3t—39 to 48 inches; brown (10YR 4/3) silty clay loam; few fine faint grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) and few fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; thin discontinuous clay films; few dark colored oxides; medium acid; gradual smooth boundary.

C—48 to 60 inches; brown (10YR 4/3) silty clay loam; massive; firm; few fine dark colored oxides; medium acid.

The solum ranges from 36 to 60 inches in thickness. The A horizon is black (10YR 2/1) or very dark gray (10YR 3/1) and grades to very dark grayish brown (10YR 3/2) in the lower part. It ranges from 18 to 30 inches in thickness. The B horizon is 15 to 30 inches thick. It is brown (10YR 4/3) or dark yellowish brown (10YR 4/4). The B2t horizon is 32 to 36 percent clay.

Zook series

The Zook series consists of poorly drained, slowly permeable soils on low, flat flood plains. Zook soils formed in silty alluvium and under a native vegetation of grasses and sedges. Slopes range from 0 to 2 percent.

Zook soils are similar to and adjacent to the more friable Colo soils, which are usually closer to the stream. Some areas of Zook soils are adjacent to Bremer, Nevin, and Wiota soils on wide bottoms that have benches or second bottoms. The Bremer soils are poorly drained, the Nevin soils are somewhat poorly drained, and the Wiota soils are well drained or moderately well drained.

Typical pedon of Zook silty clay loam, 0 to 2 percent slopes, in a field of bean stubble; located 1,640 feet south and 250 feet east of the northwestern corner of sec. 7, T. 80 N., R. 14 W.

Ap—0 to 7 inches; black (N 2/0) silty clay loam, black (10YR 2/1) dry; weak and moderate fine granular structure; firm; slightly acid; clear smooth boundary.

A12—7 to 18 inches; black (N 2/0) silty clay loam, black (10YR 2/1) dry; moderate very fine granular structure; firm; slightly acid; diffuse smooth boundary.

A13—18 to 24 inches; black (N 2/0) silty clay loam, black (10YR 2/1) dry; moderate medium blocky structure; firm; thin discontinuous clay films or sheen on faces of peds; slightly acid; gradual smooth boundary.

A3—24 to 43 inches; very dark gray (10YR 3/1) silty clay loam; moderate medium blocky structure; firm; thin discontinuous clay films or sheen on faces of peds; slightly acid; gradual smooth boundary.

Bg—43 to 51 inches; very dark gray (10YR 3/1) silty clay loam; moderate medium blocky structure; firm; thin discontinuous clay films or sheen on faces of peds; few dark oxides; neutral; gradual smooth boundary.

Cg—51 to 60 inches; black (10YR 2/1) and dark gray (10YR 4/1) silty clay loam; massive with some vertical cleavage; firm; sheen on cleavage faces; few dark oxides; neutral.

The solum is typically 40 inches or more thick and ranges from 36 to 64 inches in thickness. The mollic epipedon ranges from 36 to 50 inches or more in thickness.

The A horizon is medium silty clay loam or light silty clay that is between 35 and 42 percent clay. It ranges from about 26 to 40 inches or more in thickness. It is

black (10YR 2/1 or N 0) in the upper part and black or very dark gray (10YR 3/1) in the lower part. Value of 3 or lower extends to a depth of 36 inches or more. The B horizon is weakly expressed. The C horizon is black (10YR 2/1), very dark gray (10YR 3/1), dark gray (10YR to 5Y 4/1), and gray (5Y 5/1). Some faint mottles that have high chroma and value are below a depth of 36 inches.

formation of the soils

This section discusses the factors of soil formation and relates these factors to the soils in Poweshiek County.

factors of soil formation

Soil is produced by the action of soil-forming processes on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by 1) the physical and mineralogical composition of the parent material; 2) the climate under which the soil material has accumulated and existed since accumulation; 3) the plant and animal life on and in the soil; 4) the relief, or lay of the land; and 5) the length of time the processes of soil development have acted on the soil materials (*5*).

Climate and vegetation are the active factors in the formation of soil. They act on the parent material and slowly change it into a natural body with genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent material also affects the kind of profile that can be formed and, in extreme cases, determines it almost entirely. Finally time is needed to change the parent material into a soil profile. It may be much or little, but some time is always required for horizon differentiation. A long period generally is required for the development 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 other four. Many of the processes of soil development are unknown.

parent material and its geologic origin.

Most of the soils in Poweshiek County formed from loess, windblown materials; glacial till, ice-laid materials; and alluvium, water-laid materials. A few areas of eolian sand are adjacent to the North Skunk River and Walnut Creek. In most places parent materials are built up like layers of a cake. These layers can be observed in road cuts and, in some places, on side slopes. In this county parent material is important in developing the general character of the soil profile.

The major Pleistocene deposits of pre-Wisconsin Age are either Kansan or Nebraskan drift, or both. The different drifts, or tills, are not readily differentiated in Poweshiek County. The glacial till ranges from none to 300 feet thick.

The soils on the Kansan till plain formed during the Yarmouth and Sangamon Interglacial Ages. This was before the loess deposition. On nearly level, interstream divides, the soils were strongly weathered and had a gray, plastic subsoil, often called gumbotil. This gumbotil remains; it is several feet thick and very slowly permeable. The Clarinda soils formed in this gumbotil (*11*).

Geologic erosion has cut into and below the Yarmouth-Sangamon paleosol and into the Kansan till or other older deposits (fig. 13). The surface is characterized generally by a stone line on top of the till and erosional sediments, called pedisediment. Soils that have a red, clayey subsoil formed from the pedisediment, stone line, and subjacent till. This period of erosion and soil formation is called Late Sangamon. The Adair soils formed in the Late Sangamon paleosols (*6*).

The Kansan till is exposed mostly in hilly areas. The unweathered till is firm, calcareous clay loam. It contains pebbles, boulders, and sand, as well as silt and clay. The soils that formed in Kansan till during the Yarmouth and the Sangamon Ages were covered by loess. Geologic erosion has removed the loess and paleosols on many side slopes. In these places the till is only slightly weathered at the surface and was exposed only during the Wisconsin Stage of the Quaternary System (*11*). Shelby, Gara, and Lindley soils formed in slightly weathered glacial till.

Glacial till is exposed in many rolling areas. The till was truncated during the early part of loess deposition in the Wisconsin Age. The surface of exposed till is called the Iowan Erosion Surface (*11*).

The Iowan erosion surface is in the northeastern part of the county. The loess cap on the summits thins on shoulders and side slopes. Dinsdale soils formed in thin loess and glacial till. Geologic erosion has reworked the glacial till on slopes. Liscomb soils formed in the loamy, surficial sediment and glacial till.

The loess of Wisconsin Age covers most of the county and is an extensive parent material. It consists mainly of silt and clay particles that have been deposited by wind. Variations in the loess are related to the distance from the source of loess. The major deposits of loess are older than 14,000 years (*11*).

On the stable upland divides of the Kansan till plain, the loess is about 18 feet thick. Killduff, Tama,

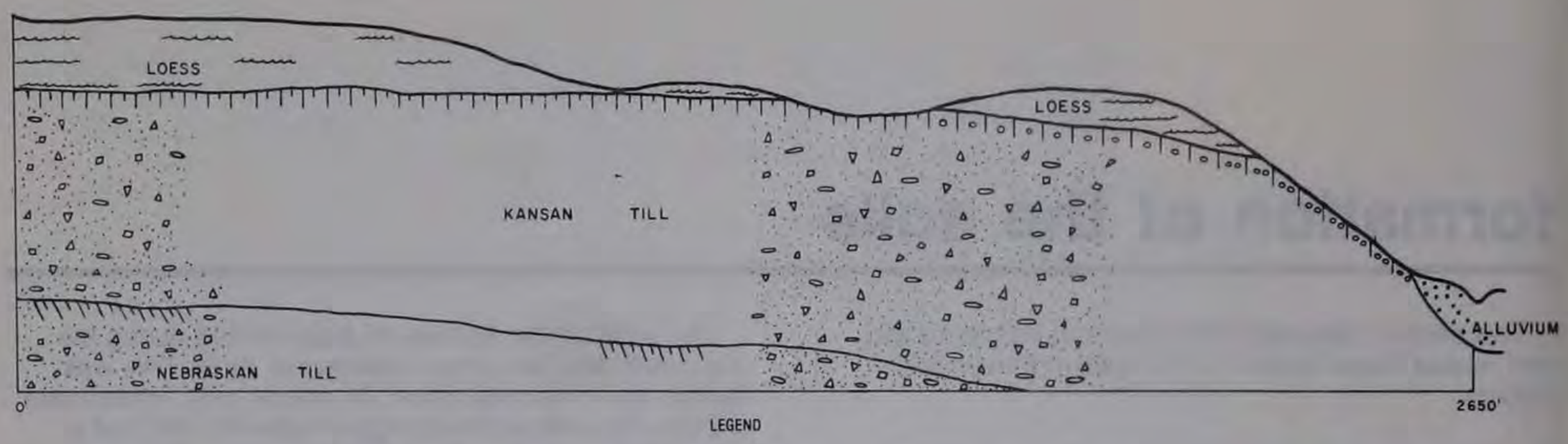


Figure 13.—Geomorphic profile traverse shows the relationship of Yarmouth Sangamon surface to the Late Sangamon pediment.

Muscatine, Garwin, Sperry, Otley, Mahaska, Taintor, and Nira soils formed in loess on this landform.

On the Iowan Surface the loess is about 10 feet thick. Tama, Muscatine, Garwin and Sperry soils formed in loess on this landscape. Dinsdale soils formed in both the loess and glacial till.

Loess deposits along the rivers that dissect the Kansan plain are thick. Downs, Fayette, Tama, Hedrick, Nira, and Killduff soils formed in this loess. Some of the high benches along the major streams and rivers are covered with loess deposits as thin as 5 feet.

Alluvium consists of sediments that have been laid down by water. As they move with the water, these sediments are sorted to some extent, but only in a few places are they as well sorted as the loess. Also, alluvium does not have the wide range of particle sizes that is in glacial drift.

Alluvial sediments are the parent materials for the soils on flood plains, on low benches, and in long drainageways. As the river overflows its channels and the water spreads over the flood plains, coarse textured materials, such as sand and coarse silt, are deposited first. As the flooding water continues to spread, it moves more slowly, and finer textured sediments are deposited. After the flood has passed, the finest particles, or clay, settle from the water that is left standing in the lowest part of the flood plain. The Ackmore, Nodaway, and Lawson soils commonly are closest to the stream channel and are coarser textured than the other soils on flood plains. Ackmore and Colo soils are in upland drainageways as well as on the flood plains of larger streams. Colo soils are extensive. Zook soils commonly are on the lower part of the bottom land and are one of the finest textured soils derived from alluvium in the county.

Alluvial benches along streams are intermediate in elevation between the flood plains and the loess-covered benches. Wiota, Nevin, Koszta, Watkins, and Bremer soils formed in the silty alluvium on this landform.

Sediments that have accumulated at the foot of the slope on which they originated are called colluvium, or local alluvium. Ely and Judson soils formed in the sediment on the foot slopes. Downslope from these soils are alluvial sediments carried in from distant sources.

Eolian deposits of sand are mainly in the uplands adjacent to Sugar Creek and North Skunk River. Some sandy areas are in the northeast part of the county. The Sparta and Chelsea soils formed in this material. These soils are mainly fine sand and have a low content of clay.

climate

These soils have been forming under a midcontinental, subhumid climate for the past 5,000 years. The morphology and properties of most of the soils indicate that this climate was similar to the present climate. From 6,500 to 16,000 years ago, however, the climate probably was cool and moist and conducive mostly to growth of forest vegetation.

The influence of the general climate in a region is modified by local conditions in or near the forming soils. For example, soils on south-facing slopes formed under a microclimate that is warmer and drier than the average climate of soils in nearby areas. The low-lying, poorly drained soils on bottom lands formed under a wetter and colder microclimate than then soils in most areas around them. These local differences influence the characteristics of the soil and account for some of the differences among soils in the same climatic region.

vegetation and animal life

Many changes in climate and vegetation took place in Iowa during the past 28,000 years (*10*). The period

between 28,000 and 11,000 years ago was dominated by coniferous forest with a transition period of birch and alder. Deciduous forest dominated the time period of 11,000 to 9,000 years ago. A very dry period occurred between 9,000 and 3,200 years, with prairie vegetation dominating. Trees, especially oak, have invaded the prairie since 3,200 years ago, but the prairie still dominates.

For the past 5,000 years, the soils appear to have been influenced by two main kinds of vegetation, prairie grasses and trees. Big bluestem and little bluestem were the main prairie grasses on uplands. The main trees were deciduous, mainly oak, hickory, ash, elm, and maple.

The effects of vegetation on soils similar to those in the county have been studied recently. Evidence shows that vegetation shifted on soils forming in areas that border trees and grasses. The morphology of the Atterberry, Downs, Gara, and Ladoga soils reflects the influence of both trees and grasses. The Chelsea, Clinton, Fayette, Armstrong, and Lindley soils formed under the influence of trees (*8*). Grasses influenced the formation of the Tama, Muscatine, Garwin, Otley, Mahaska, Taintor, Colo, Killduff, Shelby, and Zook soils and the remaining minor soils in the county.

In most places the soils that formed under trees are lighter colored, are more acid, and have a thinner surface layer than soils that formed under grasses. The thinner surface layer is lower in organic matter content. The soils in the county that formed under shifting vegetation, or mixed grasses and trees, have properties that are intermediate between the properties of soils formed under grasses and those of soils formed under trees.

Animals, such as earthworms and burrowing animals, help keep the soil open and porous. Bacteria and fungi decompose the vegetation, thus releasing nutrients for plant food.

relief

Relief also can cause important differences between soils. It indirectly influences soil formation by its effect on drainage. The slopes range from level to very steep. In many areas of the bottom lands, the nearly level soils are frequently flooded and have a permanently high or a periodically high water table. Water soaks into the depressions of nearly level soils that are subject to flooding. Much of the rainfall runs off the steep soils on uplands.

Level soils are on the broad, upland flats and on the stream bottoms. The very steepest soils in the county are generally on slopes near the major streams and their tributaries. The intricate pattern of drainageways in uplands indicates that the landscape has been modified by geological processes in most of the county.

Some soils are affected by the seasonal high water table. Where the seasonal high water table is well below the subsoil, the subsoil is yellowish brown. Examples of such soils are the Downs, Killduff, Shelby, and Tama soils. The Muscatine, Nevin, and similar soils formed where the seasonal high water table fluctuated and was periodically high. The Garwin, Taintor, and similar soils formed where the water table is high, and they have a subsoil that is dominantly grayish. The Colo, Garwin, Taintor, Zook and similar soils formed under prairie grasses and have a high water table. These poorly drained soils contain more organic matter in the surface layer than do well drained soils formed under prairie grasses. Clay is translocated in the subsoil of such soils as the Sperry soils, which are slightly depressional or nearly level. This is because a large amount of water enters the soils and carries clay particles downward.

In Killduff, Shelby, Tama, and similar soils that have wide ranges in slope, some properties change as slope increases. Two of these properties are depth to carbonates and the thickness of the surface layer. Depth to carbonates is shallow where slopes are steepest. The surface layer becomes thin in stronger sloping soils.

time

Time is required for a soil to form. An older and more strongly formed soil shows well-defined genetic horizons. A soil that has less formation shows no horizons or only weakly defined ones. Most soils on the flood plains are of this kind because soil materials have not been in place long enough for distinct horizons to develop.

As an example, the effects of time can be seen by the increase of clay in the subsoil. A high clay content in the subsoil compared to that in the surface soil indicates a high degree of soil profile development has taken place. This can be important because soils that have a high clay content in the subsoil generally have poorer drainage.

Material is generally removed from soils on steep slopes before a thick profile with strong horizons has had time to develop. Also much of the water runs off the slopes rather than through the soil material. Even though the parent material has been in place for a long time, the soil exhibits little development.

Most of the parent materials are thousands of years old. The present land surface and many soils are much younger because of recent geologic erosion (*11*).

The oldest soils are those formed in loess on upland summits and on nearly level, loess-covered benches along streams. Garwin, Muscatine, Sperry, and Tama soils might be as old as 14,000 years (*9*).

The Liscomb and other strongly sloping soils on the lowan Erosion Surface are as young as or younger than 3,000 years. The Shelby soils and other strongly sloping or steep soils on the Kansan till plain are as young as or younger than 6,800 years. Soils that formed in alluvium and eolian sand are only a few thousand years old or less. Wiota, Bremer, and other soils that formed in materials on benches along streams are the oldest

alluvial soils. Colo, Zook, and other soils that formed in materials on the flood plains are younger than Wiota and Bremer soils. Sparta and Chelsea soils are of an age intermediate between Shelby and Wiota soils. Two soils that formed in alluvium, namely Nodaway and Ackmore soils, are less than 125 years old.

man's influence on the soil

Important changes take place in the soil when it is cultivated. Some of these changes have little effect on productivity; others have a drastic effect. Changes caused by erosion generally are most apparent. On many of the cultivated soils in the county, particularly the gently rolling to hilly ones, part or all of the original surface layer has been lost through sheet erosion. In some places shallow to deep gullies have formed.

A study of eroded soils in Iowa, including Poweshiek County, was started in 1974 by the Iowa Cooperative Soil Survey. Soil descriptions and laboratory data of selected sites are available. Initial results show a lower organic matter content in eroded soils.

Nodaway and Ackmore soils formed in stratified alluvium of silt loam. They are on alluvial fans and flood plains. This alluvium has been deposited on the bottoms during the past 125-year period of cultivation. Many sloping soils have lost topsoil by erosion onto these recent deposits. About 50 percent of the soils in Poweshiek County are eroded.

In many continuously cultivated fields, the granular structure that was apparent when the grassland was undisturbed is no longer present. In these fields the surface tends to bake and harden when it dries. Fine textured soils that have been plowed when too wet tend to puddle and are less permeable than similar soils in undisturbed areas. Poor seedling emergence and root penetration are the result. Man has done much to increase productivity of the soils and to reclaim areas that were not suitable for crops. He has made large areas of bottom land suitable for cultivation by constructing drainage ditches, subsurface drains, and diversions and dikes. Broad flats and nearly level soils, such as Garwin and Taintor soils, have been greatly improved for cultivation by installing some type of drainage system. By adding commercial fertilizers, man has counteracted deficiencies in plant nutrients and has made some soils more productive than they were in their natural state.

processes of horizon differentiation

Horizon differentiation is considered to be caused by four basic kinds of change. These are additions, removals, transfers, and transformations in the soil (*12*). Each of these four kinds of change affects many substances that compose soils. For example, there may be additions, removals, transfers, or transformations of organic matter, soluble salts, carbonates, sesquioxides, or silicate clay materials.

In general, these processes tend to promote horizon differentiation, but some tend to offset or retard it. These processes and the changes brought about by them proceed simultaneously in soils. The ultimate nature of the profile is governed by the balance of these changes within the profile.

An accumulation of organic matter is an early step in the process of horizon differentiation in most soils. Soils range from very high to very low in the amount of organic matter that has accumulated in the surface layer. Some soils that were formerly quite high in organic matter are now low because of erosion. The accumulation of organic matter has been an important process in the differentiation of soil horizons.

The process through which substances are removed from parts of the soil profile is important in the differentiation of soil horizons. The movement of calcium carbonates and bases downward in soils is an example. All the soils in the county have been leached free of calcium carbonates in the upper part of the profile. Some soils have been so strongly leached that they are strongly acid or very strongly acid even in their subsoil.

Phosphorus is removed from the subsoil by plant roots and transferred to parts of the plant growing above the ground. Then the phosphorus is returned to the surface layer in the plant residue. These processes affect the forms and distribution of phosphorus in the profile.

The translocation of silicate clay minerals is another important process. The clay minerals are carried downward from the surface layer. They are suspended in percolating water. They accumulate in the subsoil in pores and root channels and as clay films. This process has had an influence on the profiles of many of the soils. In other soils the clay content of the horizons is not markedly different and other evidence of clay movement is minimal.

Shrinking and swelling is another kind of transfer, which is minimal in most soils but occurs to some extent in the very clayey soils. Shrinking and swelling causes cracks to form and the incorporation of some materials from the surface layer into lower parts of the profile. Clarinda soils are examples of soils with potential for this kind of physical transfer.

Transformations are physical and chemical. For example, soil particles are weathered to smaller sizes. The reduction of iron is another example of a transformation. This process is called gleying and involves the saturation of the soil with water for long periods in the presence of organic matter. It is characterized by the presence of ferrous iron and gray colors. Gleying is associated with poorly drained soils, such as the Garwin soils. Reductive extractable iron, or free iron, is normally lower in somewhat poorly drained soils, such as the Muscatine soils (*14*).

Still another kind of transformation is the weathering of the primary apatite mineral, which is present in soil parent materials, to secondary phosphorus compounds.

references

(1) American Association of State Highway [and Transportation] Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 vol., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) Benton, T. H. and A. E. Shearin. 1929. Soil survey of Poweshiek County, Iowa. U. S. Dep. Agric., Bur. of Chem. and Soils, and Iowa Exp. Stn., 39 pp.

(4) Brown, T. E., T. H. Benton, H. R. Meldrum, and A. J. Englehorn. 1935. Soil survey of Iowa, Poweshiek County. Iowa Agric. Exp. Stn., Soil Survey Report No. 74, 64 pp.

(5) Jenny, Hans. 1941. Factors of soil formation. McGraw-Hill Book Company, Inc., 281 pp., illus.

(6) Lane, G. H. 1941. Pollen analysis of interglacial plants of Iowa. Iowa Geol. Surv. Ann. Rep. (1934-1939) 37: 237-260, illus.

(7) Parker, L. F. 1911. History of Poweshiek County. The S. J. Clarke Pub. Co., vol. 1: 392 pp.

(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 natura of soils. Soil Sci. 82: 441-445, illus.

(11) Ruhe, Robert V. 1969. Quaternary landscapes in Iowa. Iowa State Univ. Press, 255 pp., illus.

(12) Simonson, Roy W. 1959. Outline of a generalized theory of soil genesis. Soil Sci. Soc. Am. Proc. 23: 152-156, illus.

(13) United States Department of Agriculture. 1951. Soil survey manual. U. S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplements replacing pp. 173-188 issued May 1962]

(14) United States Department of Agriculture. 1966. Soil laboratory data and descriptions for some soils of Iowa. U. S. Dep. Agric., Soil Conserv. Serv., in coop. Iowa Agric. Exp. Stn., Soil Surv. Invest. Rep. 3, 181 pp.

(15) 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.

(16) United States Department of Agriculture and Iowa Department of Agriculture. 1975. Iowa agriculture statistics. pp. 5-19.

glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Broad-base terrace. A ridge-type terrace built to control erosion by diverting runoff along the contour at a nonscouring velocity. The terrace is 10 to 20 inches high and 15 to 30 feet wide and has gently sloping sides, a rounded crown, and a dish-shaped channel along the upper side. It may be nearly level or have a grade toward one or both ends.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Chiseling. Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

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) 15.2 to 38.1 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 slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is

not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Conservation tillage. A tillage system that does not invert the soil and that leaves all or part of the crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or arresting grazing for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are

frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide 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.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity*.

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

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 melt water.

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 7.5 centimeters) in diameter. An individual piece is a pebble.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The

material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.
R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

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.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—
Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.
Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.
Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.
Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.
Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.
Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.
Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

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. 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.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Paleosol. A fossil or relict soil that was formed during the geologic past and was preserved by burial from sedimentation after it formed.

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 sediment that covers a pediment rather thinly. A pediment is an erosion surface that lies at the foot of a receded slope and is underlain by rocks or sediment of the uplands.

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 0.20 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.)

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor filter (in tables). Because of rapid permeability or an impermeable layer near the surface, the soil may not adequately filter effluent from a waste disposal system.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

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.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake (in tables). The slow movement of water into the soil.

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 (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

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.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single 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.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon, the A1 horizon, the A2 horizon, or A3 horizon, below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A horizon including all subdivisions of this horizon: the A1 horizon, the A2 horizon, and the A3 horizon.

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. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

rrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

in layer (in tables). Otherwise suitable soil material too thin for the specified use.

lth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

e slope. The outermost inclined surface at the base of a hill; part of a foot slope.

psoil. 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.

stable fill (in tables). Risk of caving or sloughing on banks of fill material.

land (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 melt water. 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.

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 to 1973 at Grinnell, Iowa]

Month	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily maximum	Average daily minimum	Average daily	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days[1]	Average	Less than--	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----	27.5	8.2	17.9	54	-22	0	1.16	.38	1.78	3	7.0
February---	33.3	13.8	23.5	58	-17	0	1.10	.36	1.69	3	7.0
March------	43.4	22.9	33.2	77	-4	20	2.40	1.10	3.48	6	7.9
April------	60.1	36.8	48.5	86	16	81	3.40	2.04	4.71	7	1.1
May--------	71.7	48.0	59.8	90	27	331	4.17	2.31	5.68	8	.0
June-------	81.1	58.1	69.7	90	40	591	4.75	2.69	6.43	7	.0
July-------	84.9	62.1	73.5	98	45	729	4.45	2.53	6.01	7	.0
August-----	83.3	59.5	71.4	97	44	663	3.79	1.86	5.36	6	.0
September--	75.3	50.9	63.1	93	31	393	3.90	1.88	5.55	6	.0
October----	65.0	40.2	52.6	87	18	189	2.19	.86	3.27	5	.1
November---	47.4	26.7	37.1	73	1	11	1.89	.72	2.82	3	1.9
December---	33.4	15.4	24.4	61	-15	0	1.43	.71	2.02	4	7.1
Year-----	58.9	36.9	47.9	98	-22	3,008	34.69	28.50	40.60	65	32.1

[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° F.)

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951 to 1973 at Grinnell, 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--	April 26	May 7	May 23
2 years in 10 later than--	April 21	May 2	May 16
5 years in 10 later than--	April 12	April 22	May 4
First freezing temperature in fall:			
1 year in 10 earlier than--	October 9	September 30	September 24
2 years in 10 earlier than--	October 14	October 5	September 29
5 years in 10 earlier than--	October 24	October 15	October 8

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-73 at Grinnell, 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	175	153	131
8 years in 10	181	161	140
5 years in 10	195	176	156
2 years in 10	208	190	172
1 year in 10	215	198	181

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
5	Ackmore-Colo complex, 0 to 2 percent slopes	3,000	0.8
7	Wiota silty clay loam, 0 to 2 percent slopes	525	0.1
8B	Judson silty clay loam, 2 to 5 percent slopes	1,270	0.3
8C	Judson silty clay loam, 5 to 9 percent slopes	400	0.1
11B	Colo-Ely silty clay loams, 2 to 5 percent slopes	15,715	4.2
20C	Killduff silty clay loam, 5 to 9 percent slopes	2,400	0.6
20C2	Killduff silty clay loam, 5 to 9 percent slopes, moderately eroded	13,780	3.7
20D2	Killduff silty clay loam, 9 to 14 percent slopes, moderately eroded	7,090	1.9
24D2	Shelby loam, 9 to 14 percent slopes, moderately eroded	4,635	1.2
24E	Shelby loam, 14 to 18 percent slopes	600	0.1
24E2	Shelby loam, 14 to 18 percent slopes, moderately eroded	5,295	1.4
24F	Shelby loam, 18 to 40 percent slopes	505	0.1
41C	Sparta loamy fine sand, 5 to 9 percent slopes	480	0.1
41D	Sparta loamy fine sand, 9 to 18 percent slopes	225	0.1
43	Bremer silty clay loam, 0 to 2 percent slopes	905	0.2
51	Vesser silt loam, 0 to 2 percent slopes	1,130	0.3
54	Zook silty clay loam, 0 to 2 percent slopes	2,565	0.7
65D	Lindley loam, 9 to 14 percent slopes	705	0.2
65E	Lindley loam, 14 to 18 percent slopes	7,000	1.9
65E3	Lindley soils, 14 to 18 percent slopes, severely eroded	565	0.1
65F	Lindley loam, 18 to 25 percent slopes	2,035	0.5
65F3	Lindley soils, 18 to 25 percent slopes, severely eroded	1,355	0.4
65G	Lindley loam, 25 to 40 percent slopes	455	0.1
75	Givin silt loam, 0 to 2 percent slopes	360	0.1
76B	Ladoga silt loam, 2 to 5 percent slopes	3,105	0.8
76C	Ladoga silt loam, 5 to 9 percent slopes	240	0.1
76C2	Ladoga silt loam, 5 to 9 percent slopes, moderately eroded	3,250	0.9
76D	Ladoga silt loam, 9 to 14 percent slopes	340	0.1
76D2	Ladoga silt loam, 9 to 14 percent slopes, moderately eroded	4,075	1.1
80C	Clinton silt loam, 5 to 9 percent slopes	790	0.2
80C2	Clinton silt loam, 5 to 9 percent slopes, moderately eroded	875	0.2
80D	Clinton silt loam, 9 to 14 percent slopes	1,585	0.4
80D2	Clinton silt loam, 9 to 14 percent slopes, moderately eroded	1,410	0.4
80E2	Clinton silt loam, 14 to 18 percent slopes, moderately eroded	205	0.1
88	Nevin silty clay loam, 0 to 2 percent slopes	2,080	0.6
93D2	Shelby-Adair complex, 9 to 14 percent slopes, moderately eroded	5,960	1.6
93E2	Shelby-Adair complex, 14 to 18 percent slopes, moderately eroded	905	0.2
118	Garwin silty clay loam, 0 to 2 percent slopes	4,945	1.3
119	Muscatine silty clay loam, 0 to 2 percent slopes	13,915	3.7
120	Tama silty clay loam, 0 to 2 percent slopes	340	0.1
120B	Tama silty clay loam, 2 to 5 percent slopes	29,350	7.8
120C	Tama silty clay loam, 5 to 9 percent slopes	3,500	0.9
120C2	Tama silty clay loam, 5 to 9 percent slopes, moderately eroded	27,030	7.2
120D2	Tama silty clay loam, 9 to 14 percent slopes, moderately eroded	5,225	1.4
122	Sperry silt loam, 0 to 1 percent slopes	990	0.3
133	Colo silty clay loam, 0 to 2 percent slopes	12,330	3.3
133+	Colo silt loam, overwash, 0 to 2 percent slopes	10,395	2.8
162B	Downs silt loam, 2 to 5 percent slopes	785	0.2
162C2	Downs silt loam, 5 to 9 percent slopes, moderately eroded	4,210	1.1
162D	Downs silt loam, 9 to 14 percent slopes	365	0.1
162D2	Downs silt loam, 9 to 14 percent slopes, moderately eroded	5,535	1.5
163C	Fayette silt loam, 5 to 9 percent slopes	280	0.1
163C2	Fayette silt loam, 5 to 9 percent slopes, moderately eroded	425	0.1
163D2	Fayette silt loam, 9 to 14 percent slopes, moderately eroded	1,640	0.4
163E2	Fayette silt loam, 14 to 18 percent slopes, moderately eroded	2,370	0.6
179D	Gara loam, 9 to 14 percent slopes	850	0.2
179D2	Gara loam, 9 to 14 percent slopes, moderately eroded	2,540	0.7
179E	Gara loam, 14 to 18 percent slopes	610	0.2
179E2	Gara loam, 14 to 18 percent slopes, moderately eroded	16,965	4.5
179F	Gara loam, 18 to 25 percent slopes	540	0.1
192D2	Adair clay loam, 9 to 14 percent slopes, moderately eroded	2,910	0.8
220	Nodaway silt loam, 0 to 2 percent slopes	5,565	1.5
222C	Clarinda silty clay loam, 5 to 9 percent slopes	280	0.1
222C2	Clarinda silty clay loam, 5 to 9 percent slopes, moderately eroded	960	0.3
222D2	Clarinda silty clay loam, 9 to 14 percent slopes, moderately eroded	3,870	1.0
273B	Olmitz loam, 2 to 5 percent slopes	1,725	0.5
273C	Olmitz loam, 5 to 9 percent slopes	450	0.1
279	Taintor silty clay loam, 0 to 2 percent slopes	6,555	1.7
280	Mahaska silty clay loam, 1 to 3 percent slopes	7,935	2.1
281B	Otley silty clay loam, 2 to 5 percent slopes	17,300	4.6
281C	Otley silty clay loam, 5 to 9 percent slopes	900	0.2
281C2	Otley silty clay loam, 5 to 9 percent slopes, moderately eroded	18,270	4.8

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
281D2	Otley silty clay loam, 9 to 14 percent slopes, moderately eroded	2,400	0.6
291	Atterberry silt loam, 0 to 2 percent slopes	205	0.1
293D2	Chelsea-Ladoga complex, 9 to 14 percent slopes, moderately eroded	450	0.1
293E2	Chelsea-Ladoga complex, 14 to 18 percent slopes, moderately eroded	260	0.1
293F	Chelsea-Ladoga complex, 18 to 25 percent slopes	205	0.1
377C2	Dinsdale silty clay loam, 5 to 9 percent slopes, moderately eroded	530	0.1
377D2	Dinsdale silty clay loam, 9 to 14 percent slopes, moderately eroded	1,100	0.3
422	Amana silt loam, 0 to 2 percent slopes	840	0.2
424D2	Lindley-Keswick loams, 9 to 14 percent slopes, moderately eroded	2,620	0.7
425D2	Keswick loam, 9 to 14 percent slopes, moderately eroded	1,865	0.5
428B	Ely silty clay loam, 2 to 5 percent slopes	1,390	0.4
430	Ackmore silt loam, 0 to 2 percent slopes	4,150	1.1
442E2	Downs-Chelsea complex, 14 to 18 percent slopes, moderately eroded	180	*
451D2	Caleb loam, 9 to 14 percent slopes, moderately eroded	225	0.1
453	Tuskeego silt loam, 0 to 2 percent slopes	150	*
462B	Downs silt loam, benches, 2 to 5 percent slopes	335	0.1
462C2	Downs silt loam, benches, 5 to 9 percent slopes, moderately eroded	350	0.1
484	Lawson silt loam, 0 to 2 percent slopes	1,270	0.3
488C2	Downs Variant silt loam, 5 to 9 percent slopes, moderately eroded	425	0.1
488D2	Downs Variant silt loam, 9 to 14 percent slopes, moderately eroded	790	0.2
570C2	Nira silty clay loam, 5 to 9 percent slopes, moderately eroded	11,620	3.1
570D2	Nira silty clay loam, 9 to 14 percent slopes, moderately eroded	1,470	0.4
571C2	Hedrick silty clay loam, 5 to 9 percent slopes, moderately eroded	2,600	0.7
571D2	Hedrick silty clay loam, 9 to 14 percent slopes, moderately eroded	875	0.2
592D2	Mystic clay loam, 9 to 14 percent slopes, moderately eroded	325	0.1
683D2	Liscomb loam, 9 to 14 percent slopes, moderately eroded	305	0.1
687	Watkins silt loam, 0 to 2 percent slopes	620	0.2
688	Koszta silt loam, 0 to 2 percent slopes	820	0.2
792D2	Armstrong loam, 9 to 14 percent slopes, moderately eroded	8,160	2.2
822D2	Lamoni silty clay loam, 9 to 14 percent slopes, moderately eroded	3,925	1.0
822E2	Lamoni silty clay loam, 14 to 18 percent slopes, moderately eroded	2,355	0.6
876B	Ladoga silt loam, benches, 2 to 5 percent slopes	225	0.1
876C2	Ladoga silt loam, benches, 5 to 9 percent slopes, moderately eroded	355	0.1
881B	Otley silty clay loam, benches, 2 to 5 percent slopes	440	0.1
881C2	Otley silty clay loam, benches, 5 to 9 percent slopes, moderately eroded	300	0.1
993D2	Gara-Armstrong loams, 9 to 14 percent slopes, moderately eroded	4,605	1.2
993E2	Gara-Armstrong loams, 14 to 18 percent slopes, moderately eroded	2,910	0.8
1220	Nodaway-Ackmore silt loams, channeled, 0 to 2 percent slopes	4,660	1.2
5030	Quarries, limestone	140	*
5040	Orthents, loamy	200	*
	Water	640	0.2
	Total	376,960	100.0

* Less than 0.1 percent.

TABLE 5.--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	Corn	Soybeans	Oats	Kentucky bluegrass	Grass-legume hay	Bromegrass-alfalfa	Smooth bromegrass
	Bu	Bu	Bu	AUM*	Ton	AUM*	AUM*
5---------- Ackmore-Colo	105	40	58	4.0	4.4	7.3	6.0
7---------- Wiota	110	42	62	4.2	4.6	7.6	6.5
8B---------- Judson	124	47	93	4.2	5.2	8.6	7.3
8C---------- Judson	119	45	90	4.1	5.0	8.3	7.1
11B---------- Colo-Ely	112	43	84	4.2	4.5	7.6	6.3
20C---------- Killduff	118	45	88	4.0	5.0	8.3	7.2
20C2---------- Killduff	115	43	86	3.8	4.9	8.1	7.0
20D2---------- Killduff	106	40	79	3.5	4.5	7.5	6.3
24D2---------- Shelby	81	31	44	3.3	3.4	5.6	4.9
24E---------- Shelby	69	26	38	2.3	2.9	4.8	4.1
24E2---------- Shelby	66	25	36	2.1	2.7	4.5	4.0
24F---------- Shelby	---	---	---	1.8	1.2	2.0	1.0
41C---------- Sparta	56	21	42	2.0	2.3	3.8	3.0
41D---------- Sparta	---	---	35	1.4	2.2	3.6	2.8
43---------- Bremer	106	40	58	4.0	4.5	7.5	6.3
51---------- Vesser	95	36	52	3.7	4.0	5.6	5.0
54---------- Zook	96	36	72	4.0	4.0	4.8	4.0
65D---------- Lindley	69	26	40	2.6	3.0	5.1	4.4
65E---------- Lindley	---	---	---	2.0	2.2	3.3	3.0
65E3---------- Lindley	---	---	---	1.6	1.0	1.6	1.0
65F, 65F3, 65G---------- Lindley	---	---	---	1.2	0.8	1.2	1.0

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Kentucky bluegrass	Grass-legume hay	Bromegrass-alfalfa	Smooth bromegrass
	Bu	Bu	Bu	AUM*	Ton	AUM*	AUM*
75---------- Givin	119	45	65	4.2	5.0	8.3	8.3
76B---------- Ladoga	113	43	62	4.3	4.7	7.8	6.8
76C---------- Ladoga	108	41	59	4.0	4.5	7.5	6.5
76C2---------- Ladoga	105	40	57	3.9	4.4	7.3	6.3
76D---------- Ladoga	99	38	54	3.8	4.2	7.0	5.9
76D2---------- Ladoga	96	36	53	3.7	4.0	6.6	5.7
80C---------- Clinton	102	39	56	3.8	4.3	7.1	6.1
80C2---------- Clinton	99	38	54	3.6	4.2	7.0	6.0
80D---------- Clinton	93	35	51	3.6	3.9	6.5	5.6
80D2---------- Clinton	90	34	50	3.5	3.8	6.3	5.3
80E2---------- Clinton	75	29	41	2.5	3.2	5.3	4.6
88---------- Nevin	114	43	63	4.0	4.8	8.0	8.0
93D2---------- Shelby-Adair	72	28	39	2.8	3.1	5.1	4.3
93E2---------- Shelby-Adair	---	---	---	2.0	2.5	4.1	3.5
118---------- Garwin	125	47	94	4.1	5.0	8.3	7.5
119---------- Muscatine	131	50	98	4.2	5.5	9.1	7.8
120---------- Tama	127	49	95	4.2	5.3	8.6	7.6
120B---------- Tama	125	48	95	4.2	5.2	8.6	7.5
120C---------- Tama	120	46	90	4.0	5.0	8.3	7.1
120C2---------- Tama	117	44	88	3.8	4.9	8.1	7.0
120D2---------- Tama	108	41	81	3.3	4.5	7.5	6.3
122---------- Sperry	97	37	53	3.6	3.5	5.8	5.1
133---------- Colo	104	40	78	4.2	4.2	7.0	5.5

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Kentucky bluegrass	Grass-legume hay	Bromegrass-alfalfa	Smooth bromegrass
	Bu	Bu	Bu	AUM*	Ton	AUM*	AUM*
133+ Colo	109	42	82	4.2	4.3	7.0	5.8
162B Downs	119	45	95	4.1	5.0	8.3	7.1
162C2 Downs	111	42	89	3.8	4.7	7.8	6.6
162D Downs	105	40	84	3.8	4.4	7.3	6.3
162D2 Downs	102	39	82	3.6	4.3	7.1	6.1
163C Fayette	108	41	86	3.8	4.5	7.5	6.5
163C2 Fayette	105	40	84	3.6	4.4	7.5	6.5
163D2 Fayette	99	38	80	3.6	4.2	7.0	6.0
163E2 Fayette	84	32	67	3.3	3.5	5.8	5.0
179D Gara	78	30	43	2.7	3.3	5.5	4.7
179D2 Gara	75	28	41	2.5	3.1	5.1	4.5
179E Gara	---	---	---	1.7	2.5	4.1	3.3
179E2 Gara	---	---	---	1.5	2.2	3.8	3.1
179F Gara	---	---	---	1.3	1.5	2.5	1.9
192D2 Adair	54	20	30	1.9	2.3	3.8	2.9
220 Nodaway	110	42	60	4.0	4.6	7.6	6.5
222C Clarinda	63	24	34	2.7	2.6	4.3	3.7
222C2 Clarinda	55	21	30	2.3	2.2	3.6	3.3
222D2 Clarinda	46	17	25	1.7	1.8	3.0	2.9
273B Olmitz	100	38	55	3.9	4.2	7.0	6.0
273C Olmitz	95	36	52	3.7	4.0	6.6	5.7
279 Taintor	117	44	64	4.2	4.7	7.8	7.0
280 Mahaska	119	45	65	4.2	5.0	8.3	7.1

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Kentucky bluegrass	Grass-legume hay	Bromegrass-alfalfa	Smooth bromegrass
	Bu	Bu	Bu	AUM*	Ton	AUM*	AUM*
281B---------- Otley	119	45	65	4.3	5.0	8.3	7.1
281C---------- Otley	114	43	63	4.0	4.8	8.0	6.8
281C2---------- Otley	111	42	61	3.9	4.7	7.8	6.6
281D2---------- Otley	102	39	56	3.7	4.3	7.1	6.1
291---------- Atterberry	125	47	93	4.0	5.0	8.3	7.3
293D2---------- Chelsea-Ladoga	---	---	41	2.2	2.3	3.8	3.5
293E2---------- Chelsea-Ladoga	---	---	---	1.9	2.0	3.2	3.0
293F---------- Chelsea-Ladoga	---	---	---	1.8	1.8	2.9	2.6
377C2---------- Dinsdale	111	42	83	3.8	4.6	7.6	6.6
377D2---------- Dinsdale	102	39	76	3.6	4.4	7.3	6.1
422---------- Amana	110	42	60	4.1	4.6	7.6	6.6
424D2---------- Lindley-Keswick	50	18	25	1.6	2.1	3.5	2.8
425D2---------- Keswick	44	17	24	1.3	1.8	3.0	2.7
428B---------- Ely	124	47	93	4.0	5.3	8.8	7.5
430---------- Ackmore	106	40	58	3.8	4.5	7.5	6.3
442E2---------- Downs-Chelsea	72	27	58	2.8	3.0	4.9	4.2
451D2---------- Caleb	66	25	36	2.1	2.8	4.6	4.0
453---------- Tuskeego	88	31	45	3.3	3.3	5.5	4.3
462B---------- Downs	119	45	95	4.1	5.0	8.3	7.1
462C2---------- Downs	111	42	89	3.8	4.7	7.8	6.6
484---------- Lawson	119	45	90	4.1	5.0	8.3	7.3
488C2---------- Downs Variant	106	38	86	3.7	4.6	7.6	6.5
488D2---------- Downs Variant	95	33	77	3.5	4.2	6.9	6.0

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Kentucky bluegrass	Grass-legume hay	Bromegrass-alfalfa	Smooth bromegrass
	Bu	Bu	Bu	AUM*	Ton	AUM*	AUM*
570C2---------- Nira	106	40	58	3.9	4.5	7.5	6.3
570D2---------- Nira	97	36	53	3.5	4.1	6.8	5.8
571C2---------- Hedrick	101	38	55	3.6	4.2	7.0	6.1
571D2---------- Hedrick	92	35	51	3.4	3.9	6.5	5.7
592D2---------- Mystic	51	19	28	1.9	2.0	3.3	2.3
683D2---------- Liscomb	88	32	61	3.1	3.6	6.0	5.2
687---------- Watkins	105	40	58	3.7	4.4	7.3	6.3
688---------- Koszta	108	41	59	3.7	4.5	7.5	6.5
792D2---------- Armstrong	50	19	28	1.7	2.0	3.3	2.7
822D2---------- Lamoni	61	23	33	2.1	2.6	4.3	3.7
822E2---------- Lamoni	---	---	---	1.9	2.1	3.5	2.5
876B---------- Ladoga	113	43	62	4.3	4.7	7.8	6.8
876C2---------- Ladoga	105	40	57	3.9	4.4	7.3	6.3
881B---------- Otley	119	45	65	4.3	5.0	8.3	7.1
881C2---------- Otley	111	42	61	3.9	4.7	7.8	6.6
993D2---------- Gara-Armstrong	66	24	36	2.2	2.7	4.4	3.8
993E2---------- Gara-Armstrong	---	---	---	1.4	2.0	3.6	3.2
1220---------- Nodaway-Ackmore	---	---	---	3.5	2.0	4.0	3.5
5030**. Quarries							
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 6.--CAPABILITY CLASSES AND SUBCLASSES

[Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)		
		Erosion (e)	Wetness (w)	Soil problem (s)
		Acres	Acres	Acres
I	18,865	---	---	---
II	106,879	70,774	36,105	---
III	137,097	135,957	1,140	---
IV	45,112	43,872	1,240	---
V	31,004	---	31,004	---
VI	32,067	31,222	---	845
VII	4,946	4,410	---	536
VIII	---	---	---	---

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	
5*: Ackmore---------- Colo.	2o	Slight	Slight	Slight	Slight	White oak----------	65	Eastern white pine, red pine, European larch, black walnut, sugar maple, poplar.
41C, 41D---------- Sparta	2s	Slight	Slight	Severe	Slight	Northern red oak----	70	Eastern white pine, red pine, jack pine.
						Red pine----------	---	
						Eastern white pine--	---	
						Jack pine----------	---	
43---------- Bremer	3w	Slight	Severe	Moderate	Moderate	Eastern cottonwood--	90	American sycamore, common hackberry, green ash, eastern cottonwood, silver maple, northern white-cedar.
						Silver maple-------	80	
65D---------- Lindley	3o	Slight	Slight	Slight	Slight	White oak----------	60	White oak, green ash, yellow-poplar, sugar maple.
65E---------- Lindley	3r	Moderate	Moderate	Slight	Slight	White oak----------	60	White oak, green ash, yellow-poplar, sugar maple.
65E3*---------- Lindley	4r	Moderate	Moderate	Moderate	Slight	White oak----------	50	White oak, green ash, yellow-poplar, sugar maple.
65F, 65F3*, 65G---- Lindley	4r	Moderate	Moderate	Slight	Slight	White oak----------	60	White oak, green ash, yellow-poplar, sugar maple.
76B, 76C, 76C2, 76D, 76D2--------- Ladoga	2o	Slight	Slight	Slight	Slight	White oak----------	75	Eastern white pine, red pine, European larch, eastern redcedar, sugar maple, white spruce.
						Northern red oak----	75	
80C, 80C2, 80D, 80D2---------- Clinton	3o	Slight	Slight	Slight	Slight	White oak----------	65	Eastern white pine, red pine, European larch, black walnut.
						Northern red oak----	65	
80E2---------- Clinton	3r	Moderate	Moderate	Slight	Slight	White oak----------	65	Eastern white pine, red pine, European larch, black walnut.
						Northern red oak----	65	
162B, 162C2, 162D, 162D2---------- Downs	2o	Slight	Slight	Slight	Slight	White oak----------	80	Eastern white pine, northern red oak, green ash, Scotch pine, yellow-poplar.
						Northern red oak----	80	
						Yellow-poplar-------	90	
						Black walnut--------	---	
163C, 163C2, 163D2- Fayette	2o	Slight	Slight	Slight	Slight	White oak----------	80	Eastern white pine, northern red oak, green ash, Scotch pine, yellow-poplar.
						Northern red oak----	80	
						Yellow-poplar-------	90	
						Black walnut--------	---	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	
163E2-------------- Fayette	2r	Moderate	Moderate	Slight	Slight	White oak---------- Northern red oak---- Yellow-poplar------- Black walnut--------	80 80 90 ---	Eastern white pine, northern red oak, green ash, Scotch pine, yellow-poplar.
179D, 179D2-------- Gara	3o	Slight	Slight	Slight	Slight	White oak---------- Northern red oak----	55 55	Eastern white pine, red pine, Scotch pine.
179E, 179E2, 179F-- Gara	3r	Moderate	Moderate	Slight	Slight	White oak---------- Northern red oak----	55 55	Eastern white pine, red pine, Scotch pine.
220---------------- Nodaway	2o	Slight	Slight	Slight	Slight	White oak----------	65	Eastern white pine, red pine, European larch, black walnut, sugar maple.
291---------------- Atterberry	2o	Slight	Slight	Slight	Slight	Northern red oak---- White oak---------- Silver maple-------- White ash---------- Green ash----------	65 65 90 65 65	Eastern white pine, red pine, silver maple, green ash.
293D2*: Chelsea-----------	3s	Slight	Slight	Moderate	Slight	White oak---------- Red pine---------- Eastern white pine-- Jack pine---------- Northern red oak----	70 72 83 70 70	Eastern white pine, red pine, jack pine.
Ladoga-----------	2o	Slight	Slight	Slight	Slight	White oak---------- Northern red oak----	75 75	Eastern white pine, red pine, European larch, eastern redcedar, sugar maple, white spruce.
293E2*, 293F*: Chelsea-----------	3s	Moderate	Moderate	Moderate	Slight	White oak---------- Red pine---------- Eastern white pine-- Jack pine---------- Northern red oak----	70 72 83 70 70	Eastern white pine, red pine, jack pine.
Ladoga-----------	2r	Moderate	Moderate	Slight	Slight	White oak---------- Northern red oak----	75 75	Eastern white pine, red pine, European larch, eastern redcedar, sugar maple, white spruce.
422---------------- Amana	3o	Slight	Slight	Slight	Slight	White oak---------- Northern red oak----	62 58	Eastern white pine, red pine, European larch, black walnut, sugar maple.
424D2*: Lindley-----------	4o	Slight	Slight	Slight	Slight	White oak----------	50	White oak, green ash, yellow-poplar, sugar maple.
Keswick-----------	3c	Slight	Slight	Moderate	Moderate	White oak---------- Northern red oak----	55 55	Eastern white pine, red pine, European larch, sugar maple.
425D2-------------- Keswick	3c	Slight	Slight	Moderate	Moderate	White oak---------- Northern red oak----	55 55	Eastern white pine, red pine, European larch, sugar maple.

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	
430---------- Ackmore	2o	Slight	Slight	Slight	Slight	White oak----------	65	Eastern white pine, red pine, European larch, black walnut, sugar maple, poplar.
442E2*: Downs----------	2r	Moderate	Moderate	Slight	Slight	White oak----------	80	Eastern white pine, northern red oak, green ash, Scotch pine, yellow-poplar.
						Northern red oak----	80	
						Yellow-poplar-------	90	
						Black walnut--------	---	
Chelsea----------	3s	Slight	Slight	Moderate	Slight	White oak----------	70	Eastern white pine, red pine, jack pine.
						Red pine----------	72	
						Eastern white pine--	83	
						Jack pine----------	70	
						Quaking aspen-------	72	
						Northern red oak----	70	
451D2---------- Caleb	3o	Slight	Slight	Slight	Slight	White oak----------	55	Eastern white pine, red pine, European larch, black walnut, sugar maple.
						Northern red oak----	55	
453---------- Tuskeego	3w	Slight	Severe	Moderate	Moderate	Eastern cottonwood--	90	Eastern cottonwood, silver maple, American sycamore, green ash, northern white-cedar.
						Silver maple--------	80	
462B, 462C2-------- Downs	2o	Slight	Slight	Slight	Slight	White oak----------	80	Eastern white pine, northern red oak, green ash, Scotch pine, yellow-poplar.
						Northern red oak----	80	
						Yellow-poplar-------	90	
						Black walnut--------	---	
484---------- Lawson	4o	Slight	Slight	Slight	Slight	Silver maple--------	70	White spruce, silver maple, white ash.
						White ash----------	---	
						American elm--------	---	
488C2, 488D2------- Downs Variant	2o	Slight	Slight	Slight	Slight	White oak----------	65	Eastern white pine, northern red oak, black walnut, sugar maple.
						Northern red oak----	65	
571C2, 571D2------- Hedrick	2o	Slight	Slight	Slight	Slight	White oak----------	75	Eastern white pine, red pine, eastern redcedar, sugar maple, white spruce.
592D2---------- Mystic	4c	Slight	Slight	Severe	Severe	White oak----------	55	Eastern white pine, red pine, European larch, black walnut, sugar maple.
						Northern red oak----	55	
687---------- Watkins	3o	Slight	Slight	Slight	Slight	White oak----------	70	Eastern white pine, red pine, European larch, sugar maple.
688---------- Koszta	2o	Slight	Slight	Slight	Slight	White oak----------	65	Eastern white pine, red pine, white oak, northern red oak, sugar maple, white spruce.
						Northern red oak----	70	
792D2---------- Armstrong	4c	Slight	Slight	Slight	Severe	White oak----------	55	Eastern white pine, red pine, European larch, black walnut, sugar maple, poplar.
						Northern red oak----	55	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	
876B, 876C2-------- Ladoga	2o	Slight	Slight	Slight	Slight	White oak---------- Northern red oak----	75 75	Eastern white pine, red pine, European larch, eastern redcedar, sugar maple, white spruce.
993D2*: Gara----------	3o	Slight	Slight	Slight	Slight	White oak---------- Northern red oak----	55 55	Eastern white pine, red pine, Scotch pine.
Armstrong---------	4c	Slight	Slight	Slight	Severe	White oak---------- Northern red oak----	55 55	Eastern white pine, red pine, European larch, black walnut, sugar maple, poplar.
993E2*: Gara----------	3r	Moderate	Moderate	Slight	Slight	White oak---------- Northern red oak----	55 55	Eastern white pine, red pine, Scotch pine.
Armstrong---------	4c	Moderate	Moderate	Slight	Severe	White oak---------- Northern red oak----	55 55	Eastern white pine, red pine, European larch, black walnut, sugar maple, poplar.
1220*: Nodaway----------	2o	Slight	Slight	Slight	Slight	White oak----------	65	Eastern white pine, red pine, European larch, black walnut, sugar maple.
Ackmore----------	2o	Slight	Slight	Slight	Slight	White oak----------	65	Eastern white pine, red pine, European larch, black walnut, sugar maple, poplar.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
5*:					
Ackmore	Silky dogwood, gray dogwood.	Redosier dogwood, Tatarian honeysuckle, lilac.	Amur maple, eastern redcedar.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
Colo	Gray dogwood, silky dogwood.	Tatarian honeysuckle, redosier dogwood, Zabel honeysuckle.	Laurel willow, white spruce, Amur maple, northern white-cedar.	Green ash	Silver maple, eastern cottonwood.
7, Wiota	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
8B, 8C, Judson	Silky dogwood, gray dogwood.	Tatarian honeysuckle, redosier dogwood, Siberian peashrub.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
11B*:					
Colo	Gray dogwood, silky dogwood.	Tatarian honeysuckle, redosier dogwood, Zabel honeysuckle.	Laurel willow, white spruce, Amur maple, northern white-cedar.	Green ash	Silver maple, eastern cottonwood.
Ely	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
20C, 20C2, 20D2, Killduff	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
24D2, 24E, 24E2, 24F, Shelby	Silky dogwood, gray dogwood.	Tatarian honeysuckle, lilac, redosier dogwood.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
41C, 41D, Sparta	Common ninebark, lilac.	Eastern redcedar, autumn-olive.	Austrian pine, green ash.	---	---
43, Bremer	Silky dogwood, gray dogwood.	Redosier dogwood, Tatarian honeysuckle, American plum, Zabel honeysuckle.	Laurel willow, northern white-cedar, Amur maple.	Green ash	Eastern cottonwood, silver maple.
51, Vesser	Silky dogwood	Redosier dogwood, American plum, Tatarian honeysuckle, eastern redcedar, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash	Eastern cottonwood, silver maple.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
54---------- Zook	Silky dogwood-----	Gray dogwood, Tatarian honeysuckle, Zabel honeysuckle, American plum, redosier dogwood.	Northern white-cedar, laurel willow, Amur maple.	Green ash---------	Silver maple, eastern cottonwood.
65D, 65E, 65E3*, 65F, 65F3*, 65G-- Lindley	Silky dogwood-----	Amur honeysuckle, autumn-olive, American plum.	Amur maple, eastern redcedar, Russian-olive.	Eastern white pine, green ash, pin oak.	European alder, silver maple.
75---------- Givin	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
76B, 76C, 76C2, 76D, 76D2-------- Ladoga	Gray dogwood, silky dogwood.	Redosier dogwood, lilac, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
80C, 80C2, 80D, 80D2, 80E2------- Clinton	Silky dogwood, gray dogwood.	Lilac, Tatarian honeysuckle, redosier dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
88---------- Nevin	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
93D2*, 93E2*: Shelby----------	Silky dogwood, gray dogwood.	Tatarian honeysuckle, lilac, redosier dogwood.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
Adair----------	Silky dogwood, gray dogwood.	Lilac, Tatarian honeysuckle, redosier dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
118---------- Garwin	Silky dogwood, gray dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash---------	Eastern cottonwood, silver maple.
119---------- Muscatine	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
120, 120B, 120C, 120C2, 120D2----- Tama	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Silver maple, eastern cottonwood.
122---------- Sperry	Silky dogwood, gray dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash---------	Eastern cottonwood, silver maple.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
133, 133+--------- Colo	Gray dogwood, silky dogwood.	Tatarian honeysuckle, redosier dogwood, Zabel honeysuckle.	Laurel willow, white spruce, Amur maple, northern white-cedar.	Green ash---------	Silver maple, eastern cottonwood.
162B, 162C2, 162D, 162D2---------- Downs	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
163C, 163C2, 163D2, 163E2----- Fayette	Gray dogwood, common ninebark.	Redosier dogwood, Tatarian honeysuckle, American plum.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
179D, 179D2, 179E, 179E2, 179F------ Gara	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
192D2---------- Adair	Silky dogwood, gray dogwood.	Lilac, Tatarian honeysuckle, redosier dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
220---------- Nodaway	Gray dogwood, common ninebark.	Redosier dogwood, Tatarian honeysuckle, purpleosier willow.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
222C, 222C2, 222D2---------- Clarinda	Silky dogwood-----	Redosier dogwood, American plum, Tatarian honeysuckle, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash---------	Eastern cottonwood, silver maple.
273B, 273C-------- Olmitz	Gray dogwood, silky dogwood.	Redosier dogwood, Tatarian honeysuckle, American plum.	Amur maple, eastern redcedar.	Red pine, Norway spruce, common hackberry.	Silver maple, eastern cottonwood.
279---------- Taintor	Silky dogwood, gray dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash---------	Eastern cottonwood, silver maple.
280---------- Mahaska	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
281B, 281C, 281C2, 281D2---------- Otley	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
291---------- Atterberry	Silky dogwood-----	Northern white-cedar, American cranberrybush, lilac.	White spruce, black spruce.	Eastern white pine, red pine.	Red maple, silver maple, green ash, white ash.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
293D2*: Chelsea	Lilac, common ninebark.	Siberian peashrub, eastern redcedar, autumn-olive, Russian-olive, northern white-cedar.	Ponderosa pine, common hackberry, Austrian pine, Scotch pine.	---	---
Ladoga	Gray dogwood, silky dogwood.	Redosier dogwood, lilac, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
293E2*, 293F*: Chelsea.					
Ladoga	Gray dogwood, silky dogwood.	Redosier dogwood, lilac, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
377C2, 377D2--- Dinsdale	Gray dogwood, silky dogwood.	Redosier dogwood, Amur honeysuckle, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
422--- Amana	Gray dogwood, silky dogwood.	Redosier dogwood, Tatarian honeysuckle, purpleosier willow.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Silver maple, eastern cottonwood.
424D2*: Lindley	Silky dogwood	Amur honeysuckle, autumn-olive, American plum.	Amur maple, eastern redcedar, Russian-olive.	Eastern white pine, green ash, pin oak.	European alder, silver maple.
Keswick	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
425D2--- Keswick	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
428B--- Ely	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
430--- Ackmore	Silky dogwood, gray dogwood.	Redosier dogwood, Tatarian honeysuckle, lilac.	Amur maple, eastern redcedar.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
442E2*: Downs	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
Chelsea	Lilac, common ninebark.	Siberian peashrub, eastern redcedar, autumn-olive, Russian-olive, northern white-cedar.	Ponderosa pine, common hackberry, Austrian pine, Scotch 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 heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
451D2---------- Caleb	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
453---------- Tuskeego	Silky dogwood, gray dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash---------	Eastern cottonwood, silver maple.
462B, 462C2------- Downs	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
484---------- Lawson	Redosier dogwood, gray dogwood.	Northern white-cedar, redosier dogwood, nannyberry viburnum, autumn-olive, silky dogwood.	Jack pine, white ash, white spruce.	Eastern white pine, silver maple.	---
488C2, 488D2------ Downs Variant	Silky dogwood, gray dogwood.	Redosier dogwood, American plum, lilac, Tatarian honeysuckle.	White spruce, Amur maple, northern white-cedar.	Ponderosa pine, common hackberry.	Silver maple.
570C2, 570D2------ Nira	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
571C2, 571D2------ Hedrick	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
592D2---------- Mystic	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
683D2---------- Liscomb	Gray dogwood------	Silky dogwood, Tatarian honeysuckle, American plum, redosier dogwood.	Amur maple, eastern redcedar.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
687---------- Watkins	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
688---------- Koszta	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
792D2---------- Armstrong	Gray dogwood, silky dogwood.	Redosier dogwood, Tatarian honeysuckle, American plum.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Silver maple, eastern cottonwood.
822D2, 822E2------ Lamoni	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
876B, 876C2---------- Ladoga	Gray dogwood, silky dogwood.	Redosier dogwood, lilac, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
881B, 881C2---------- Otley	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
993D2*, 993E2*: Gara----------	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
Armstrong----------	Gray dogwood, silky dogwood.	Redosier dogwood, Tatarian honeysuckle, American plum.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Silver maple, eastern cottonwood.
1220*: Nodaway----------	Gray dogwood, common ninebark.	Redosier dogwood, Tatarian honeysuckle, purpleosier willow.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
Ackmore----------	Silky dogwood, gray dogwood.	Redosier dogwood, Tatarian honeysuckle, lilac.	Amur maple, eastern redcedar.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
5030*. Quarries					
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
5*:					
Ackmore	Severe: floods, wetness.	Moderate: wetness, floods.	Severe: wetness, floods.	Moderate: wetness, floods.	Severe: floods.
Colo	Severe: floods, wetness.	Moderate: floods, wetness.	Severe: wetness, floods.	Moderate: floods, wetness.	Severe: floods.
7 Wiota	Severe: floods.	Slight	Slight	Slight	Slight.
8B Judson	Slight	Slight	Moderate: slope.	Slight	Slight.
8C Judson	Slight	Slight	Severe: slope.	Slight	Slight.
11B*:					
Colo	Severe: floods, wetness.	Moderate: floods, wetness.	Severe: wetness, floods.	Moderate: floods, wetness.	Severe: floods.
Ely	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
20C, 20C2 Killduff	Slight	Slight	Severe: slope.	Slight	Slight.
20D2 Killduff	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
24D2 Shelby	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope,	Slight	Moderate: slope.
24E, 24E2 Shelby	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
24F Shelby	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
41C Sparta	Slight	Slight	Severe: slope.	Slight	Moderate: droughty.
41D Sparta	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.
43 Bremer	Severe: wetness, floods.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
51 Vesser	Severe: floods, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, floods.
54 Zook	Severe: wetness, floods.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, floods.

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
65D---------- Lindley	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight----------	Moderate: slope.
65E, 65E3*, 65F, 65F3*---------- Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
65G---------- Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
75---------- Givin	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Slight----------	Slight.
76B---------- Ladoga	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
76C, 76C2---------- Ladoga	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
76D, 76D2---------- Ladoga	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
80C, 80C2---------- Clinton	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Severe: erodes easily.	Slight.
80D, 80D2---------- Clinton	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
80E2---------- Clinton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
88---------- Nevin	Severe: floods.	Moderate: wetness.	Moderate: wetness.	Slight----------	Slight.
93D2*: 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.
93E2*: Shelby----------	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Adair----------	Severe: slope, wetness.	Severe: slope.	Severe: slope, wetness.	Moderate: wetness, slope.	Severe: slope.
118---------- Garwin	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
119---------- Muscatine	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight----------	Slight.
120---------- Tama	Slight----------	Slight----------	Slight----------	Slight----------	Slight.
120B---------- Tama	Slight----------	Slight----------	Moderate: slope.	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
120C, 120C2---------- Tama	Slight---------	Slight---------	Severe: slope.	Slight----------	Slight.
120D2---------- Tama	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
122---------- Sperry	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
133---------- Colo	Severe: floods, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, floods.
133+---------- Colo	Severe: floods, wetness.	Moderate: floods, wetness.	Severe: wetness, floods.	Moderate: floods, wetness.	Severe: floods.
162B---------- Downs	Slight---------	Slight---------	Moderate: slope.	Slight----------	Slight.
162C2---------- Downs	Slight---------	Slight---------	Severe: slope.	Slight----------	Slight.
162D, 162D2---------- Downs	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
163C, 163C2---------- Fayette	Slight---------	Slight---------	Severe: slope.	Slight----------	Slight.
163D2---------- Fayette	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
163E2---------- Fayette	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
179D, 179D2---------- Gara	Moderate: percs slowly, slope.	Moderate: slope, percs slowly.	Severe: slope.	Slight----------	Moderate: slope.
179E, 179E2, 179F----- Gara	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
192D2---------- Adair	Severe: wetness.	Moderate: wetness, slope, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: slope, wetness.
220---------- Nodaway	Severe: floods.	Slight---------	Moderate: floods.	Slight----------	Moderate: floods.
222C, 222C2---------- Clarinda	Severe: percs slowly, wetness.	Severe: percs slowly.	Severe: slope, wetness, percs slowly.	Severe: erodes easily.	Moderate: wetness.
222D2---------- Clarinda	Severe: percs slowly, wetness.	Severe: percs slowly.	Severe: slope, wetness, percs slowly.	Severe: erodes easily.	Moderate: wetness, slope.
273B---------- Olmitz	Slight---------	Slight---------	Moderate: slope.	Slight----------	Slight.
273C---------- Olmitz	Slight---------	Slight---------	Severe: slope.	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
279 Taintor	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
280 Mahaska	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
281B Otley	Slight	Slight	Moderate: slope.	Slight	Slight.
281C, 281C2 Otley	Slight	Slight	Severe: slope.	Slight	Slight.
281D2 Otley	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
291 Atterberry	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
293D2*: Chelsea	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope, droughty.
Ladoga	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
293E2*, 293F*: Chelsea	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Ladoga	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
377C2 Dinsdale	Slight	Slight	Severe: slope.	Slight	Slight.
377D2 Dinsdale	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
422 Amana	Severe: floods.	Slight	Moderate: floods.	Slight	Moderate: floods.
424D2*: Lindley	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.
Keswick	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness, slope.
425D2 Keswick	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness, slope.
428B Ely	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
430 Ackmore	Severe: floods, wetness.	Moderate: wetness, floods.	Severe: wetness, floods.	Moderate: wetness, floods.	Severe: floods.

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
442E2*: Downs	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Chelsea	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope, droughty.
451D2 Caleb	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
453 Tuskeego	Severe: floods, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
462B Downs	Slight	Slight	Moderate: slope.	Slight	Slight.
462C2 Downs	Slight	Slight	Severe: slope.	Slight	Slight.
484 Lawson	Severe: floods, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, floods.
488C2 Downs Variant	Slight	Slight	Severe: slope.	Slight	Slight.
488D2 Downs Variant	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
570C2 Nira	Slight	Slight	Severe: slope.	Slight	Slight.
570D2 Nira	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
571C2 Hedrick	Slight	Slight	Severe: slope.	Slight	Slight.
571D2 Hedrick	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
592D2 Mystic	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
683D2 Liscomb	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
687 Watkins	Severe: floods.	Slight	Slight	Slight	Slight.
688 Koszta	Severe: floods.	Moderate: wetness.	Moderate: wetness.	Slight	Slight.
792D2 Armstrong	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: slope, wetness.
822D2 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
822E2---------- Lamoni	Severe: slope, wetness, percs slowly.	Severe: slope, percs slowly.	Severe: slope, wetness.	Moderate: wetness, slope.	Severe: slope.
876B---------- Ladoga	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
876C2---------- Ladoga	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
881B---------- Otley	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
881C2---------- Otley	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
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.
1220*: Nodaway----------	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.	Severe: floods.
Ackmore----------	Severe: floods, wetness.	Moderate: wetness, floods.	Severe: wetness, floods.	Moderate: wetness, floods.	Severe: floods.
5030*. Quarries					
5040*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
5*: Ackmore	Very poor.	Poor	Good	Good	Good	Fair	Fair	Poor	Good	Fair.
Colo	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
7 Wiota	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
8B Judson	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
8C Judson	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
11B*: Colo	Good	Fair	Good	Fair	Poor	Fair	Very poor.	Fair	Fair	Poor.
Ely	Good	Good	Good	Good	Good	Fair	Very poor.	Good	Good	Poor.
20C, 20C2 Killduff	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
20D2 Killduff	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
24D2 Shelby	Fair	Good	Fair	Good	Good	Poor	Poor	Fair	Good	Poor.
24E, 24E2 Shelby	Poor	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Fair	Poor.
24F Shelby	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Fair	Very poor.
41C, 41D Sparta	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
43 Bremer	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
51 Vesser	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
54 Zook	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
65D Lindley	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
65E, 65E3*, 65F, 65F3* 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.
75 Givin	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
76B---------- Ladoga	Good	Good	Fair	Good	Good	Poor	Poor	Good	Good	Poor.
76C, 76C2, 76D, 76D2---------- Ladoga	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Very poor.
80C, 80C2, 80D, 80D2---------- Clinton	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
80E2---------- Clinton	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
88---------- Nevin	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
93D2*: Shelby----------	Fair	Good	Fair	Good	Good	Poor	Poor	Fair	Good	Poor.
Adair----------	Fair	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
93E2*: Shelby----------	Poor	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Fair	Poor.
Adair----------	Fair	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
118---------- Garwin	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
119---------- Muscatine	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
120, 120B---------- Tama	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
120C, 120C2, 120D2- Tama	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
122---------- Sperry	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
133, 133+---------- Colo	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
162B---------- Downs	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
162C2, 162D, 162D2- Downs	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
163C, 163C2, 163D2- Fayette	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
163E2---------- Fayette	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
179D, 179D2-------- Gara	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Poor.
179E, 179E2, 179F-- Gara	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
192D2---------- Adair	Fair	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
220---------- Nodaway	Good	Good	Good	Good	Fair	Fair	Poor	Fair	Good	Fair.
222C, 222C2, 222D2- Clarinda	Poor	Fair	Poor	Fair	Poor	Poor	Poor	Fair	Fair	Poor.
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.
279---------- Taintor	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
280---------- Mahaska	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
281B---------- Otley	Good	Good	Fair	Good	Good	Poor	Poor	Good	Good	Poor.
281C, 281C2, 281D2- Otley	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Very poor.
291---------- Atterberry	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
293D2*:										
Chelsea----------	Very poor.	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Ladoga----------	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Very poor.
293E2*, 293F*:										
Chelsea----------	Very poor.	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Ladoga----------	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
377C2, 377D2------- Dinsdale	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
422---------- Amana	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Good.
424D2*:										
Lindley----------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Keswick----------	Fair	Good	Fair	Good	Fair	Very poor.	Poor	Fair	Good	Very poor.
425D2---------- Keswick	Fair	Good	Fair	Good	Fair	Very poor.	Poor	Fair	Good	Very poor.
428B---------- Ely	Good	Good	Good	Good	Good	Fair	Very poor.	Good	Good	Poor.
430---------- Ackmore	Very poor.	Poor	Good	Good	Good	Fair	Fair	Poor	Good	Fair.
442E2*:										
Downs----------	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
442E2*: Chelsea	Very poor.	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
451D2--- Caleb	Fair	Good	Fair	Good	Fair	Poor	Poor	Fair	Good	Poor.
453--- Tuskeego	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
462B--- Downs	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
462C2--- Downs	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
484--- Lawson	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
488C2, 488D2--- Downs Variant	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
570C2, 570D2--- Nira	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Very poor.
571C2, 571D2--- Hedrick	Fair	Good	Fair	Good	Good	Poor	Poor	Fair	Good	Poor.
592D2--- Mystic	Fair	Good	Fair	Good	Fair	Very poor.	Poor	Fair	Good	Very poor.
683D2--- Liscomb	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
687--- Watkins	Good	Good	Fair	Good	Good	Poor	Poor	Good	Good	Poor.
688--- Koszta	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
792D2--- Armstrong	Fair	Good	Fair	Good	Fair	Very poor.	Poor	Fair	Good	Very poor.
822D2--- Lamoni	Fair	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
822E2--- Lamoni	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
876B--- Ladoga	Good	Good	Fair	Good	Good	Poor	Poor	Good	Good	Poor.
876C2--- Ladoga	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Very poor.
881B--- Otley	Good	Good	Fair	Good	Good	Poor	Poor	Good	Good	Poor.
881C2--- Otley	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Very poor.
993D2*: Gara---	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
993D2*:										
Armstrong	Fair	Good	Fair	Good	Fair	Very poor.	Poor	Fair	Good	Very poor.
993E2*:										
Gara	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Armstrong	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
1220*:										
Nodaway	Poor	Fair	Fair	Poor	Poor	Good	Fair	Poor	Poor	Fair.
Ackmore	Very poor.	Poor	Good	Good	Good	Fair	Fair	Poor	Good	Fair.
5030*. Quarries										
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]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
5*: Ackmore	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness.	Severe: low strength, floods, frost action.	Severe: floods.
Colo	Severe: wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, low strength, frost action.	Severe: floods.
7 Wiota	Slight	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, frost action.	Slight.
8B Judson	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
8C Judson	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
11B*: Colo	Severe: wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, low strength, frost action.	Severe: floods.
Ely	Severe: wetness.	Severe: low strength.	Severe: low strength, wetness.	Severe: low strength.	Severe: frost action, low strength.	Slight.
20C, 20C2 Killduff	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: low strength, frost action.	Slight.
20D2 Killduff	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
24D2 Shelby	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
24E, 24E2, 24F Shelby	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
41C Sparta	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
41D Sparta	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
43 Bremer	Severe: wetness.	Severe: wetness, shrink-swell, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, shrink-swell, floods.	Severe: low strength, frost action.	Moderate: wetness.
51 Vesser	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, low strength, frost action.	Moderate: wetness, floods.

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
54---------- Zook	Severe: wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, low strength, frost action.	Moderate: wetness, floods.
65D---------- Lindley	Moderate: dense layer, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
65E, 65E3*, 65F, 65F3*, 65G------- Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
75---------- Givin	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action, low strength.	Slight.
76B---------- Ladoga	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
76C, 76C2--------- Ladoga	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
76D, 76D2--------- Ladoga	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
80C, 80C2--------- Clinton	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
80D, 80D2--------- Clinton	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
80E2---------- Clinton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
88---------- Nevin	Severe: wetness.	Severe: floods.	Severe: wetness, floods.	Severe: floods.	Severe: frost action, low strength.	Slight.
93D2*: 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: low strength, frost action.	Moderate: slope, wetness.
93E2*: Shelby----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Adair----------	Severe: wetness, slope.	Severe: shrink-swell, wetness, slope.	Severe: wetness, slope.	Severe: shrink-swell, wetness, slope.	Severe: low strength, slope, frost action.	Severe: slope.
118---------- Garwin	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: frost action, low strength, 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
119---------- Muscatine	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
120, 120B---------- Tama	Slight----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action, low strength.	Slight.
120C, 120C2------- Tama	Slight----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.	Slight.
120D2---------- Tama	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
122---------- Sperry	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, frost action.	Severe: ponding.
133---------- Colo	Severe: wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, low strength, frost action.	Moderate: wetness, floods.
133+---------- Colo	Severe: wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, low strength, frost action.	Severe: floods.
162B---------- Downs	Slight----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action, low strength.	Slight.
162C2---------- Downs	Slight----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.	Slight.
162D, 162D2------- Downs	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
163C, 163C2------- Fayette	Slight----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.	Slight.
163D2---------- Fayette	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
163E2---------- Fayette	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: frost action, low strength, slope.	Severe: slope.
179D, 179D2------- Gara	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
179E, 179E2, 179F- Gara	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
192D2---------- Adair	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness.	Severe: shrink-swell, wetness, slope.	Severe: low strength, frost action.	Moderate: slope, 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
220---------- Nodaway	Moderate: wetness, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action, low strength.	Moderate: floods.
222C, 222C2------- Clarinda	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: frost action, low strength, shrink-swell.	Moderate: wetness.
222D2---------- Clarinda	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: frost action, low strength, shrink-swell.	Moderate: wetness, slope.
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.
279---------- Taintor	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
280---------- Mahaska	Severe: wetness.	Moderate: shrink-swell, wetness.	Severe: wetness.	Moderate: shrink-swell, wetness.	Severe: low strength, frost action.	Slight.
281B---------- Otley	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
281C, 281C2------- Otley	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: low strength.	Slight.
281D2---------- Otley	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
291---------- Atterberry	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
293D2*: Chelsea----------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope, droughty.
Ladoga----------	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
293E2*, 293F*: Chelsea----------	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Ladoga----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
377C2---------- Dinsdale	Slight---------	Moderate: shrink-swell.	Slight---------	Moderate: slope, shrink-swell.	Severe: frost action, low strength.	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
377D2---------- Dinsdale	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
422---------- Amana	Moderate: floods, wetness.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, low strength, frost action.	Moderate: floods.
424D2*: Lindley----------	Moderate: dense layer, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
Keswick----------	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell, slope.	Severe: low strength, frost action.	Moderate: wetness, slope.
425D2---------- Keswick	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell, slope.	Severe: low strength, frost action.	Moderate: wetness, slope.
428B---------- Ely	Severe: wetness.	Severe: low strength.	Severe: low strength, wetness.	Severe: low strength.	Severe: frost action, low strength.	Slight.
430---------- Ackmore	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness.	Severe: low strength, floods, frost action.	Severe: floods.
442E2*: Downs----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action, low strength.	Severe: slope.
Chelsea----------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope, droughty.
451D2---------- Caleb	Moderate: wetness, slope.	Moderate: shrink-swell, slope.	Moderate: wetness, slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
453---------- Tuskeego	Severe: wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
462B---------- Downs	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action, low strength.	Slight.
462C2---------- Downs	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.	Slight.
484---------- Lawson	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, frost action.	Moderate: wetness, floods.
488C2---------- Downs Variant	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	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
488D2---------- Downs Variant	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
570C2---------- Nira	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
570D2---------- Nira	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
571C2---------- Hedrick	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: low strength, frost action.	Slight.
571D2---------- Hedrick	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
592D2---------- Mystic	Moderate: too clayey, wetness, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, frost action.	Moderate: slope.
683D2---------- Liscomb	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
687---------- Watkins	Slight---------	Severe: floods.	Severe: floods.	Severe: floods.	Severe: frost action, low strength.	Slight.
688---------- Koszta	Severe: wetness.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Severe: low strength, frost action.	Slight.
792D2---------- Armstrong	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness.	Severe: shrink-swell, wetness, slope.	Severe: low strength, frost action.	Moderate: slope, wetness.
822D2---------- Lamoni	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness, slope.	Severe: shrink-swell, low strength.	Moderate: wetness, slope.
822E2---------- Lamoni	Severe: wetness, slope.	Severe: wetness, shrink-swell, slope.	Severe: shrink-swell, wetness, slope.	Severe: shrink-swell, wetness, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope.
876B---------- Ladoga	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
876C2---------- Ladoga	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
881B---------- Otley	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
881C2---------- Otley	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: low strength.	Slight.
993D2*: Gara----------	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: 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
993D2*: Armstrong	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness.	Severe: shrink-swell, wetness, slope.	Severe: low strength, frost action.	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.	Severe: shrink-swell, wetness, slope.	Severe: low strength, frost action, slope.	Severe: slope.
1220*: Nodaway	Moderate: wetness, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action, low strength.	Severe: floods.
Ackmore	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness.	Severe: low strength, floods, frost action.	Severe: floods.
5030*. Quarries						
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," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
5*:					
Ackmore	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness, hard to pack.
Colo	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness, hard to pack.
7 Wiota	Moderate: floods, percs slowly.	Severe: floods.	Moderate: floods, too clayey.	Moderate: floods.	Fair: too clayey.
8B Judson	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
8C Judson	Slight	Severe: slope.	Slight	Slight	Good.
11B*:					
Colo	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness, hard to pack.
Ely	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
20C, 20C2 Killduff	Slight	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
20D2 Killduff	Moderate: slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: slope, too clayey.
24D2 Shelby	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.
24E, 24E2, 24F Shelby	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
41C, 41D Sparta	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
43 Bremer	Severe: percs slowly, wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness.	Poor: wetness.
51 Vesser	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
54 Zook	Severe: percs slowly, wetness, floods.	Severe: wetness, floods.	Severe: wetness, too clayey, floods.	Severe: wetness, floods.	Poor: too clayey, wetness, hard to pack.
65D Lindley	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	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
65E, 65E3*, 65F, 65F3*, 65G--------- Lindley	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
75---------- Givin	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
76B---------- Ladoga	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
76C, 76C2---------- Ladoga	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
76D, 76D2---------- Ladoga	Moderate: percs slowly, slope.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.
80C, 80C2---------- Clinton	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
80D, 80D2---------- Clinton	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.
80E2---------- Clinton	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
88---------- Nevin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
93D2*: 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.
93E2*: Shelby----------	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Adair----------	Severe: percs slowly, slope, wetness.	Severe: slope, wetness.	Severe: wetness, slope.	Severe: wetness, slope.	Poor: slope, wetness.
118---------- Garwin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
119---------- Muscatine	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
120---------- Tama	Slight----------	Moderate: seepage.	Moderate: too clayey.	Slight----------	Fair: too clayey.
120B---------- Tama	Slight----------	Moderate: slope, seepage.	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
120C, 120C2--------- Tama	Slight----------	Severe: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
120D2--------------- Tama	Moderate: slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: slope, too clayey.
122----------------- Sperry	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
133, 133+---------- Colo	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness, hard to pack.
162B---------------- Downs	Slight----------	Moderate: slope, seepage.	Moderate: too clayey.	Slight----------	Fair: too clayey.
162C2--------------- Downs	Slight----------	Severe: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
162D, 162D2--------- Downs	Moderate: slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: slope, too clayey.
163C, 163C2--------- Fayette	Slight----------	Severe: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
163D2--------------- Fayette	Moderate: slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: slope, too clayey.
163E2--------------- Fayette	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
179D, 179D2--------- Gara	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.
179E, 179E2, 179F--- Gara	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
192D2--------------- Adair	Severe: percs slowly, wetness.	Severe: slope, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
220----------------- Nodaway	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Fair: wetness.
222C, 222C2, 222D2-- Clarinda	Severe: wetness, percs slowly.	Severe: slope.	Severe: too clayey, wetness.	Severe: wetness.	Poor: too clayey, wetness, 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.
279----------------- Taintor	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
280---------- Mahaska	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
281B---------- Otley	Moderate: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight----------	Fair: too clayey.
281C, 281C2---------- Otley	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
281D2---------- Otley	Moderate: slope, percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.
291---------- Atterberry	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: hard to pack, wetness.
293D2*: Chelsea----------	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
Ladoga----------	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.
293E2*, 293F*: Chelsea----------	Severe: slope, poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy, slope.	Severe: seepage, slope.	Poor: too sandy, slope, seepage.
Ladoga----------	Severe: slope, percs slowly.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
377C2---------- Dinsdale	Slight----------	Severe: slope.	Slight----------	Slight----------	Good.
377D2---------- Dinsdale	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
422---------- Amana	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Fair: wetness.
424D2*: Lindley----------	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Keswick----------	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
425D2---------- Keswick	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
428B---------- Ely	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
430---------- Ackmore	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness, hard to pack.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
442E2*: Downs	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Chelsea	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
451D2 Caleb	Severe: wetness.	Severe: seepage, slope, wetness.	Severe: seepage.	Severe: seepage.	Fair: too clayey, slope, wetness.
453 Tuskeego	Severe: wetness, percs slowly.	Severe: floods, wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
462B Downs	Slight	Moderate: slope, seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
462C2 Downs	Slight	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
484 Lawson	Severe: floods, wetness.	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
488C2 Downs Variant	Slight	Severe: slope.	Slight	Slight	Good.
488D2 Downs Variant	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
570C2 Nira	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Poor: hard to pack.
570D2 Nira	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Poor: hard to pack.
571C2 Hedrick	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
571D2 Hedrick	Moderate: slope, percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
592D2 Mystic	Severe: wetness, percs slowly.	Severe: seepage, slope, wetness.	Severe: seepage, too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
683D2 Liscomb	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
687 Watkins	Moderate: floods.	Moderate: seepage.	Moderate: too clayey, floods.	Moderate: floods.	Fair: too clayey.
688 Koszta	Severe: wetness.	Severe: floods, wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
792D2---------- Armstrong	Severe: percs slowly, wetness.	Severe: slope.	Severe: wetness.	Severe: wetness.	Poor: wetness.
822D2---------- Lamoni	Severe: percs slowly, wetness.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
822E2---------- Lamoni	Severe: percs slowly, slope, wetness.	Severe: slope.	Severe: wetness, too clayey, slope.	Severe: wetness, slope.	Poor: too clayey, slope, hard to pack.
876B---------- Ladoga	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
876C2---------- Ladoga	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
881B---------- Otley	Moderate: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight----------	Fair: too clayey.
881C2---------- Otley	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
993D2*: Gara----------	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.
Armstrong----------	Severe: percs slowly, wetness.	Severe: slope.	Severe: wetness.	Severe: wetness.	Poor: wetness.
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.	Severe: wetness, slope.	Poor: slope, wetness.
1220*: Nodaway----------	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Fair: wetness.
Ackmore----------	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness, hard to pack.
5030*. Quarries					
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," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
5*:				
Ackmore	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
Colo	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
7 Wiota	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
8B, 8C Judson	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
11B*:				
Colo	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ely	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
20C, 20C2 Killduff	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
20D2 Killduff	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, too clayey.
24D2 Shelby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer, slope.
24E, 24E2, 24F Shelby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Severe: slope.
41C Sparta	Good	Probable	Improbable: too sandy.	Fair: too sandy.
41D Sparta	Good	Probable	Improbable: too sandy.	Fair: slope, too sandy.
43 Bremer	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
51 Vesser	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
54 Zook	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
65D Lindley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
65E, 65E3*, 65F, 65F3* Lindley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
65G---------- Lindley	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
75---------- Givin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
76B, 76C, 76C2, 76D, 76D2---------- Ladoga	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
80C, 80C2, 80D, 80D2-- Clinton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
80E2---------- Clinton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
88---------- Nevin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
93D2*: 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.
93E2*: Shelby----------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Severe: slope.
Adair----------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
118---------- Garwin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
119---------- Muscatine	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
120, 120B, 120C, 120C2---------- Tama	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
120D2---------- Tama	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
122---------- Sperry	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
133, 133+---------- Colo	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
162B, 162C2---------- Downs	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
162D, 162D2---------- Downs	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
163C, 163C2---------- Fayette	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
163D2---------- Fayette	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, thin layer.
163E2---------- Fayette	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
179D, 179D2---------- Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, small stones.
179E, 179E2, 179F----- Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
192D2---------- Adair	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
220---------- Nodaway	Good----------	Improbable: excess fines.	Improbable: excess fines.	Good.
222C, 222C2---------- Clarinda	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, thin layer.
222D2---------- Clarinda	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, thin layer, slope.
273B, 273C---------- Olmitz	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
279---------- Taintor	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, thin layer.
280---------- Mahaska	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
281B, 281C, 281C2, 281D2---------- Otley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
291---------- Atterberry	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
293D2*: Chelsea----------	Good----------	Probable----------	Improbable: too sandy.	Fair: too sandy, slope.
Ladoga----------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
293E2*, 293F*: Chelsea----------	Fair: slope.	Probable----------	Improbable: too sandy.	Poor: slope.
Ladoga----------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
377C2---------- Dinsdale	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
377D2---------- Dinsdale	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
422---------- Amana	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
424D2*: Lindley----------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Keswick----------	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
425D2---------- Keswick	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
428B---------- Ely	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
430---------- Ackmore	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
442E2*: Downs----------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Chelsea----------	Good----------	Probable----------	Improbable: too sandy.	Fair: too sandy, slope.
451D2---------- Caleb	Good----------	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
453---------- Tuskeego	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
462B, 462C2---------- Downs	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
484---------- Lawson	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
488C2---------- Downs Variant	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
488D2---------- Downs Variant	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
570C2---------- Nira	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
570D2---------- Nira	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
571C2---------- Hedrick	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
571D2---------- Hedrick	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
592D2---------- Mystic	Good----------	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
683D2---------- Liscomb	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
687---------- Watkins	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
688---------- Koszta	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
792D2---------- Armstrong	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
822D2---------- Lamoni	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
822E2---------- Lamoni	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
876B, 876C2---------- Ladoga	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
881B, 881C2---------- Otley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
993D2*: Gara---------- Armstrong----------	Poor: low strength. Poor: low strength.	Improbable: excess fines. Improbable: excess fines.	Improbable: excess fines. Improbable: excess fines.	Fair: slope, small stones. Poor: thin layer.
993E2*: Gara---------- Armstrong----------	Poor: low strength. Poor: low strength.	Improbable: excess fines. Improbable: excess fines.	Improbable: excess fines. Improbable: excess fines.	Poor: slope. Poor: slope, thin layer.
1220*: Nodaway---------- Ackmore----------	Good---------- Poor: low strength, shrink-swell.	Improbable: excess fines. Improbable: excess fines.	Improbable: excess fines. Improbable: excess fines.	Good. Good.
5030*. Quarries				
5040*. Orthents				

* 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]

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
5*: Ackmore	Moderate: seepage.	Severe: hard to pack, wetness.	Floods, frost action.	Wetness, erodes easily.	Wetness, erodes easily.	Wetness, erodes easily.
Colo	Moderate: seepage.	Severe: wetness.	Floods, frost action.	Floods, wetness.	Wetness	Wetness.
7 Wiota	Moderate: seepage.	Slight	Deep to water	Favorable	Erodes easily	Erodes easily.
8B, 8C Judson	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
11B*: Colo	Moderate: seepage, slope.	Severe: wetness.	Floods, frost action, slope.	Wetness, slope, floods.	Wetness	Wetness.
Ely	Moderate: slope, seepage.	Moderate: wetness.	Slope, frost action.	Slope, wetness.	Erodes easily, wetness.	Erodes easily.
20C, 20C2 Killduff	Moderate: seepage, slope.	Slight	Not needed	Slope	Erodes easily	Erodes easily.
20D2 Killduff	Severe: slope.	Slight	Not needed	Slope	Slope, erodes easily.	Slope, erodes easily.
24D2, 24E, 24E2, 24F Shelby	Severe: slope.	Slight	Deep to water	Slope	Slope	Slope.
41C Sparta	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
41D Sparta	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
43 Bremer	Slight	Severe: wetness, hard to pack.	Frost action	Wetness	Wetness	Wetness.
51 Vesser	Moderate: seepage.	Severe: wetness.	Floods, frost action.	Floods, frost action.	Wetness, erodes easily.	Erodes easily, wetness.
54 Zook	Slight	Severe: hard to pack, wetness.	Floods, percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
65D, 65E, 65E3*, 65F, 65F3*, 65G-- Lindley	Severe: slope.	Slight	Deep to water	Rooting depth, slope.	Slope	Slope, rooting depth.
75 Givin	Slight	Moderate: wetness, hard to pack.	Frost action	Wetness	Wetness, erodes easily.	Erodes easily.
76B, 76C, 76C2 Ladoga	Moderate: seepage, slope.	Moderate: hard to pack.	Deep to water	Slope	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
76D, 76D2--------- Ladoga	Severe: slope.	Moderate: hard to pack.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
80C, 80C2--------- Clinton	Moderate: seepage, slope.	Moderate: hard to pack.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
80D, 80D2, 80E2--- Clinton	Severe: slope.	Moderate: hard to pack.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
88---------------- Nevin	Moderate: seepage.	Moderate: wetness.	Frost action---	Wetness--------	Erodes easily, wetness.	Erodes easily.
93D2*, 93E2*: Shelby-----------	Severe: slope.	Slight---------	Deep to water	Slope----------	Slope----------	Slope.
Adair------------	Severe: slope.	Moderate: wetness.	Percs slowly, slope, frost action.	Wetness, percs slowly, slope.	Slope, wetness.	Wetness, slope.
118--------------- Garwin	Moderate: seepage.	Severe: wetness.	Frost action---	Wetness--------	Wetness--------	Wetness.
119--------------- Muscatine	Moderate: seepage.	Moderate: wetness.	Frost action---	Wetness--------	Wetness, erodes easily.	Erodes easily.
120--------------- Tama	Moderate: seepage.	Slight---------	Deep to water	Favorable------	Erodes easily	Erodes easily.
120B, 120C, 120C2- Tama	Moderate: slope, seepage.	Slight---------	Deep to water	Slope----------	Erodes easily	Erodes easily.
120D2------------- Tama	Severe: slope.	Slight---------	Deep to water	Slope----------	Erodes easily, slope.	Slope, erodes easily.
122--------------- Sperry	Slight---------	Severe: ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Erodes easily, ponding.	Wetness, erodes easily, percs slowly.
133, 133+--------- Colo	Moderate: seepage.	Severe: wetness.	Floods, frost action.	Floods, wetness.	Wetness--------	Wetness.
162B, 162C2------- Downs	Moderate: slope, seepage.	Slight---------	Deep to water	Slope----------	Erodes easily	Erodes easily.
162D, 162D2------- Downs	Severe: slope.	Slight---------	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
163C, 163C2------- Fayette	Moderate: slope, seepage.	Slight---------	Deep to water	Slope, erodes easily.	Favorable------	Erodes easily.
163D2, 163E2------ Fayette	Severe: slope.	Slight---------	Deep to water	Slope, erodes easily.	Slope----------	Slope, erodes easily.
179D, 179D2, 179E, 179E2, 179F------ Gara	Severe: slope.	Slight---------	Deep to water	Slope----------	Slope----------	Slope.
192D2------------- Adair	Severe: slope.	Moderate: wetness.	Percs slowly, slope, frost action.	Wetness, percs slowly, slope.	Slope, wetness.	Wetness, slope.
220--------------- Nodaway	Moderate: seepage.	Severe: piping.	Deep to water	Floods, erodes easily.	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
222C, 222C2------- Clarinda	Moderate: slope.	Severe: hard to pack.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Wetness, erodes easily.
222D2------------- Clarinda	Severe: slope.	Severe: hard to pack.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Slope, wetness, erodes easily.	Wetness, slope, erodes easily.
273B, 273C-------- Olmitz	Moderate: seepage, slope.	Slight---------	Deep to water	Slope----------	Favorable------	Favorable.
279--------------- Taintor	Moderate: seepage.	Severe: wetness.	Frost action---	Wetness--------	Erodes easily, wetness.	Wetness, erodes easily.
280--------------- Mahaska	Moderate: seepage.	Moderate: wetness, hard to pack.	Frost action---	Wetness--------	Wetness, erodes easily.	Erodes easily.
281B, 281C, 281C2- Otley	Moderate: seepage, slope.	Moderate: hard to pack.	Deep to water	Slope----------	Erodes easily	Erodes easily.
281D2------------- Otley	Severe: slope.	Moderate: hard to pack.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
291--------------- Atterberry	Moderate: seepage.	Severe: wetness.	Frost action---	Wetness--------	Erodes easily, wetness.	Wetness, erodes easily.
293D2*, 293E2*, 293F*: Chelsea---------	Severe: slope, seepage.	Severe: piping, seepage.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
Ladoga----------	Severe: slope.	Moderate: hard to pack.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
377C2------------- Dinsdale	Moderate: slope, seepage.	Slight---------	Deep to water	Slope----------	Erodes easily	Erodes easily.
377D2------------- Dinsdale	Severe: slope.	Slight---------	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
422--------------- Amana	Moderate: seepage.	Moderate: wetness.	Deep to water	Floods, erodes easily.	Erodes easily	Erodes easily.
424D2*: Lindley----------	Severe: slope.	Slight---------	Deep to water	Rooting depth, slope.	Slope----------	Slope, rooting depth.
Keswick----------	Severe: slope.	Moderate: wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly, rooting depth.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
425D2------------- Keswick	Severe: slope.	Moderate: wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly, rooting depth.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
428B-------------- Ely	Moderate: slope, seepage.	Moderate: wetness.	Slope, frost action.	Slope, wetness.	Erodes easily, wetness.	Erodes easily.
430--------------- Ackmore	Moderate: seepage.	Severe: hard to pack, wetness.	Floods, frost action.	Wetness, erodes easily.	Wetness, erodes easily.	Wetness, erodes easily.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
442E2*:						
Downs	Severe: slope.	Slight	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Chelsea	Severe: slope, seepage.	Severe: piping, seepage.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
451D2---------- Caleb	Severe: seepage, slope.	Moderate: thin layer.	Deep to water	Slope	Slope	Slope.
453---------- Tuskeego	Slight	Severe: thin layer, wetness.	Percs slowly	Wetness, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
462B, 462C2------- Downs	Moderate: slope, seepage.	Slight	Deep to water	Slope	Erodes easily	Erodes easily.
484---------- Lawson	Moderate: seepage.	Severe: wetness.	Floods, frost action.	Wetness, floods.	Erodes easily, wetness.	Wetness, erodes easily.
488C2---------- Downs Variant	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
488D2---------- Downs Variant	Severe: slope.	Moderate: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
570C2---------- Nira	Moderate: seepage, slope.	Moderate: hard to pack.	Deep to water	Slope	Erodes easily	Erodes easily.
570D2---------- Nira	Severe: slope.	Moderate: hard to pack.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
571C2---------- Hedrick	Moderate: seepage, slope.	Moderate: hard to pack.	Deep to water	Slope	Erodes easily	Erodes easily.
571D2---------- Hedrick	Severe: slope.	Moderate: hard to pack.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
592D2---------- Mystic	Severe: slope.	Moderate: thin layer, hard to pack.	Deep to water	Percs slowly, rooting depth, slope.	Slope, erodes easily, percs slowly.	Slope, erodes easily, rooting depth.
683D2---------- Liscomb	Severe: slope.	Slight	Deep to water	Slope	Slope	Slope.
687---------- Watkins	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
688---------- Koszta	Moderate: seepage.	Moderate: wetness.	Frost action	Wetness	Erodes easily, wetness.	Erodes easily.
792D2---------- Armstrong	Severe: slope.	Moderate: wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Slope, percs slowly, wetness.	Percs slowly, slope, wetness.
822D2, 822E2------ Lamoni	Severe: slope.	Moderate: wetness, hard to pack.	Percs slowly, slope.	Wetness, percs slowly, slope.	Slope, wetness, percs slowly.	Slope, wetness, percs slowly.
876B, 876C2------- Ladoga	Moderate: seepage, slope.	Moderate: hard to pack.	Deep to water	Slope	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
881B, 881C2------- Otley	Moderate: seepage, slope.	Moderate: hard to pack.	Deep to water	Slope----------	Erodes easily	Erodes easily.
993D2*, 993E2*: Gara----------	Severe: slope.	Slight---------	Deep to water	Slope----------	Slope----------	Slope.
Armstrong--------	Severe: slope.	Moderate: wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Slope, percs slowly, wetness.	Percs slowly, slope, wetness.
1220*: Nodaway----------	Moderate: seepage.	Severe: piping.	Deep to water	Floods, erodes easily.	Erodes easily	Erodes easily.
Ackmore----------	Moderate: seepage.	Severe: hard to pack, wetness.	Floods, frost action.	Wetness, erodes easily.	Wetness, erodes easily.	Wetness, erodes easily.
5030*. Quarries						
5040*. Orthents						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

[The symbol > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
5*:											
Ackmore	0-25	Silt 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, MH, ML	A-7, A-6	0	100	100	95-100	85-100	35-60	15-30
Colo	0-17	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	17-60	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
7 Wiota	0-21	Silty clay loam	CL	A-6	0	100	100	100	90-95	30-40	10-20
	21-48	Silty clay loam	CL	A-7	0	100	100	95-100	90-95	40-50	15-25
	48-60	Silty clay loam, silt loam.	CL	A-7	0	100	100	95-100	90-95	40-50	20-30
8B, 8C Judson	0-33	Silty clay loam	CL, CL-ML	A-6, A-7, A-4	0	100	100	100	95-100	25-50	5-25
	33-60	Silty clay loam, silt loam.	CL, CL-ML	A-6, A-7, A-4	0	100	100	100	95-100	25-50	5-25
11B*:											
Colo	0-17	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	17-60	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
Ely	0-22	Silty clay loam	CL, OL, OH, MH	A-7, A-6	0	100	100	95-100	95-100	30-55	10-25
	22-60	Silty clay loam	CL, ML	A-7, A-6	0	100	100	95-100	95-100	35-50	10-25
20C, 20C2, 20D2-- Killduff	0-9	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
	9-46	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	46-60	Silt loam, silty clay loam.	CL	A-6	0	100	100	100	95-100	30-40	10-20
24D2, 24E, 24E2, 24F	0-7	Loam	CL	A-6	0	95-100	85-95	75-90	55-70	30-40	10-20
Shelby	7-52	Clay loam	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
	52-60	Clay loam	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
41C, 41D	0-34	Loamy fine sand	SM	A-2, A-4	0	85-100	85-100	50-95	15-50	---	NP**
Sparta	34-60	Sand, fine sand	SP-SM, SM, SP	A-2, A-3	0	85-100	85-100	50-95	2-30	---	NP
43	0-16	Silty clay loam	CH, CL	A-7	0	100	100	100	95-100	45-60	25-40
Bremer	16-50	Silty clay loam, silty clay.	CH, MH	A-7	0	100	100	100	95-100	50-65	20-35
	50-60	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	40-60	25-40
51	0-17	Silt loam	CL	A-6	0	100	100	98-100	95-100	30-40	10-20
Vesser	17-32	Silt loam	CL	A-6	0	100	100	98-100	95-100	30-40	10-20
	32-60	Silty clay loam	CL, CH	A-7	0	100	100	98-100	95-100	40-55	20-30
54	0-24	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	45-65	20-35
Zook	24-60	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
65D, 65E	0-9	Loam	CL-ML, CL	A-4, A-6	0	95-100	90-100	85-95	50-65	15-30	5-15
Lindley	9-48	Clay loam, loam	CL	A-6, A-7	0	95-100	90-100	85-95	55-75	30-45	15-25
	48-60	Loam, clay loam	CL	A-6	0	95-100	90-100	85-95	50-70	30-40	15-25
65E3*	0-9	Clay loam	CL	A-6	0	95-100	90-100	85-95	55-75	30-40	10-20
Lindley	9-48	Clay loam, loam	CL	A-6, A-7	0	95-100	90-100	85-95	55-75	30-45	15-25
	48-60	Loam, clay loam	CL	A-6	0	95-100	90-100	85-95	50-70	30-40	15-25
65F	0-9	Loam	CL-ML, CL	A-4, A-6	0	95-100	90-100	85-95	50-65	15-30	5-15
Lindley	9-48	Clay loam, loam	CL	A-6, A-7	0	95-100	90-100	85-95	55-75	30-45	15-25
	48-60	Loam, clay loam	CL	A-6	0	95-100	90-100	85-95	50-70	30-40	15-25

See footnotes 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	
65F3*---------- Lindley	0-9	Clay loam--------	CL	A-6	0	95-100	90-100	85-95	55-75	30-40	10-20
	9-48	Clay loam, loam	CL	A-6, A-7	0	95-100	90-100	85-95	55-75	30-45	15-25
	48-60	Loam, clay loam	CL	A-6	0	95-100	90-100	85-95	50-70	30-40	15-25
65G---------- Lindley	0-9	Loam----------	CL-ML, CL	A-4, A-6	0	95-100	90-100	85-95	50-65	15-30	5-15
	9-48	Clay loam, loam	CL	A-6, A-7	0	95-100	90-100	85-95	55-75	30-45	15-25
	48-60	Loam, clay loam	CL	A-6	0	95-100	90-100	85-95	50-70	30-40	15-25
75---------- Givin	0-16	Silt loam--------	CL, ML	A-4, A-6	0	100	100	100	95-100	30-40	5-15
	16-37	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	100	95-100	45-60	25-35
	37-60	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	20-30
76B, 76C, 76C2, 76D, 76D2------- Ladoga	0-11	Silt loam--------	CL, CL-ML	A-6, A-4	0	100	100	100	95-100	25-40	5-15
	11-50	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	100	95-100	40-55	25-35
	50-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	100	95-100	30-40	15-20
80C, 80C2, 80D, 80D2, 80E2------ Clinton	0-10	Silt loam--------	ML	A-4	0	100	100	100	95-100	30-40	5-10
	10-60	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	100	95-100	40-55	25-35
88---------- Nevin	0-19	Silty clay loam	CL, OL	A-6, A-7	0	100	100	100	90-95	35-45	10-20
	19-51	Silty clay loam	CL	A-7	0	100	100	95-100	90-95	40-50	20-30
	51-60	Silty clay loam, silt loam.	CL	A-7	0	100	100	95-100	90-95	40-50	20-30
93D2*, 93E2*: Shelby----------	0-7	Loam----------	CL	A-6	0	95-100	85-95	75-90	55-70	30-40	10-20
	7-52	Clay loam--------	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
	52-60	Clay loam--------	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
Adair----------	0-8	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
118---------- Garwin	0-18	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	45-55	20-30
	18-54	Silty clay loam	CH, CL	A-7	0	100	100	100	95-100	45-55	25-35
	54-60	Silt loam--------	CL	A-6	0	100	100	100	95-100	30-40	15-20
119---------- Muscatine	0-17	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	15-25
	17-41	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	20-30
	41-60	Silt loam--------	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
120, 120B, 120C, 120C2, 120D2---- Tama	0-18	Silty clay loam	ML	A-6, A-7	0	100	100	100	95-100	35-50	10-20
	18-46	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	15-25
	46-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
122---------- Sperry	0-18	Silt loam--------	CL	A-6	0	100	100	100	95-100	30-40	10-20
	18-50	Silty clay loam, silty clay.	CH	A-7	0	100	100	100	95-100	50-65	25-35
	50-60	Silty clay loam, silt loam.	CL	A-7	0	100	100	100	95-100	40-50	20-30
133---------- Colo	0-17	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	17-60	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
133+---------- Colo	0-8	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
	8-26	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
	26-60	Silty clay loam, clay loam.	CL, CH	A-7	0	100	100	95-100	80-100	40-55	15-30

See footnotes 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	
162B, 162C2, 162D, 162D2-----	0-11	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	100	95-100	25-35	5-15
Downs	11-60	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-45	15-25
163C, 163C2, 163D2, 163E2----	0-12	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
Fayette	12-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
179D, 179D2, 179E, 179E2, 179F----------	0-11	Loam----------	CL, CL-ML	A-4, A-6	0	95-100	85-95	75-85	55-70	20-30	5-15
Gara	11-43	Clay loam--------	CL	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	43-60	Loam, clay loam	CL	A-6, A-7	0-5	90-95	85-95	70-85	55-75	35-45	15-25
192D2----------	0-8	Clay loam--------	CL	A-6	0	95-100	80-95	75-90	60-80	30-40	10-20
Adair	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
220----------	0-38	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-35	5-15
Nodaway	38-60	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-45	15-25
222C, 222C2, 222D2----------	0-10	Silty clay loam	CL	A-7	0	100	95-100	90-100	85-100	40-50	20-30
Clarinda	10-60	Silty clay, clay	CH	A-7	0	100	95-100	85-100	80-100	55-70	30-40
273B, 273C-------	0-16	Loam----------	CL	A-6	0	100	90-100	85-95	60-80	30-40	11-20
Olmitz	16-60	Clay loam--------	CL	A-6, A-7	0	100	90-100	85-95	60-80	35-45	15-25
279----------	0-17	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	45-60	20-30
Taintor	17-40	Silty clay, silty clay loam.	CH	A-7	0	100	100	100	95-100	50-65	25-35
	40-60	Silty clay loam, silt loam.	CL	A-7	0	100	100	100	95-100	40-50	15-25
280----------	0-20	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
Mahaska	20-40	Silty clay loam, silty clay.	CH, MH	A-7	0	100	100	100	95-100	50-60	20-30
	40-60	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-45	15-20
281B, 281C, 281C2, 281D2----	0-17	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	15-25
Otley	17-37	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	100	95-100	40-55	25-35
	37-60	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-45	20-30
291----------	0-15	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
Atterberry	15-54	Silty clay loam, silt loam.	CL, CH	A-7, A-6	0	100	100	95-100	95-100	35-55	20-30
	54-60	Silt loam--------	CL	A-6	0	100	100	95-100	95-100	30-40	10-20
293D2*, 293E2*, 293F*:											
Chelsea--------	0-19	Loamy fine sand	SM, SP-SM	A-2-4	0	100	100	65-80	10-35	---	NP
	19-60	Fine sand, sand, loamy sand.	SP, SM, SP-SM	A-3, A-2-4	0	100	100	65-80	3-15	---	NP
Ladoga---------	0-11	Silt loam--------	CL, CL-ML	A-6, A-4	0	100	100	100	95-100	25-40	5-15
	11-50	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	100	95-100	40-55	25-35
	50-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	100	95-100	30-40	15-20

See footnotes 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	
377C2, 377D2----- Dinsdale	0-6	Silty clay loam	ML, CL	A-6, A-7	0	100	100	100	95-100	30-50	10-20
	6-27	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	15-25
	27-60	Loam, clay loam, sandy clay loam.	CL	A-6	0-5	90-95	85-90	75-85	55-65	25-35	10-20
422----------- Amana	0-15	Silt loam--------	CL	A-6	0	100	100	95-100	90-95	25-40	10-20
	15-55	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	90-95	35-45	15-25
	55-60	Silt loam--------	CL	A-6	0	100	100	95-100	75-95	30-40	10-20
424D2*:											
Lindley---------	0-9	Loam-------------	CL-ML, CL	A-4, A-6	0	95-100	90-100	85-95	50-65	15-30	5-15
	9-48	Clay loam, loam	CL	A-6, A-7	0	95-100	90-100	85-95	55-75	30-45	15-25
	48-60	Loam, clay loam	CL	A-6	0	95-100	90-100	85-95	50-70	30-40	15-25
Keswick---------	0-9	Loam-------------	CL, CL-ML	A-6, A-4	0-5	90-100	80-100	75-90	60-80	20-30	5-15
	9-30	Clay loam, clay	CH, MH	A-7	0-5	90-100	80-100	70-90	55-80	50-60	20-30
	30-60	Clay loam, sandy clay loam.	CL, SC	A-6	0-5	90-100	80-100	65-85	40-70	30-40	15-25
425D2----------- Keswick	0-9	Loam-------------	CL, CL-ML	A-6, A-4	0-5	90-100	80-100	75-90	60-80	20-30	5-15
	9-30	Clay loam, clay	CH, MH	A-7	0-5	90-100	80-100	70-90	55-80	50-60	20-30
	30-60	Clay loam, sandy clay loam.	CL, SC	A-6	0-5	90-100	80-100	65-85	40-70	30-40	15-25
428B----------- Ely	0-22	Silty clay loam	CL, OL, OH, MH	A-7, A-6	0	100	100	95-100	95-100	30-55	10-25
	22-60	Silty clay loam	CL, ML	A-7, A-6	0	100	100	95-100	95-100	35-50	10-25
430----------- Ackmore	0-25	Silt 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, MH, ML	A-7, A-6	0	100	100	95-100	85-100	35-60	15-30
442E2*:											
Downs-----------	0-11	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	11-60	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-45	15-25
Chelsea---------	0-19	Loamy fine sand	SM, SP-SM	A-2-4	0	100	100	65-80	10-35	---	NP
	19-60	Fine sand, sand, loamy sand.	SP, SM, SP-SM	A-3, A-2-4	0	100	100	65-80	3-15	---	NP
451D2----------- Caleb	0-6	Loam-------------	CL	A-6	0	95-100	85-100	70-90	60-80	30-40	10-20
	6-26	Clay loam, loam, sandy clay loam.	CL	A-6, A-7	0	90-100	85-100	60-80	50-75	35-45	15-25
	26-60	Sandy clay loam, sandy loam, clay loam.	SC, CL, SM, ML	A-4, A-6, A-2	0	90-100	85-100	50-75	30-60	15-35	NP-15
453----------- Tuskeego	0-17	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	98-100	95-100	25-35	5-15
	17-41	Silty clay loam, silty clay.	CH	A-7	0	100	100	98-100	95-100	50-60	25-35
	41-60	Silty clay loam	CH, CL, ML, MH	A-7	0	100	100	98-100	95-100	45-55	25-35
462B, 462C2----- Downs	0-11	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	11-60	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-45	15-25
484----------- Lawson	0-30	Silt loam--------	CL, CL-ML	A-4	0	100	100	90-100	80-100	20-30	5-10
	30-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	90-100	80-100	20-40	10-25
488C2, 488D2----- Downs Variant	0-6	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	6-33	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-45	15-25
	33-60	Silt loam--------	CL	A-6	0	100	100	100	95-100	30-40	10-20

See footnotes 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	
570C2, 570D2----- Nira	0-7	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	15-25
	7-44	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	20-30
	44-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
571C2, 571D2----- Hedrick	0-7	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
	7-50	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	25-35
	50-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	100	95-100	30-40	15-20
592D2---------- Mystic	0-5	Clay loam--------	CL, ML	A-4, A-6, A-7	0-5	90-100	80-100	75-100	65-90	30-45	10-25
	5-29	Clay loam, clay, silty clay.	CL, CH	A-6, A-7	0-5	90-100	80-100	75-100	65-80	40-55	25-35
	29-61	Sandy clay loam, 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
683D2---------- Liscomb	0-8	Loam----------	CL	A-6	0	100	100	85-95	60-80	30-40	10-20
	8-46	Loam, sandy clay loam, clay loam.	CL, SC	A-6	0-5	95-100	90-95	85-95	45-70	30-40	10-20
	46-60	Sandy clay loam, sandy loam.	CL, SC	A-6, A-4	0-5	95-100	90-95	85-95	45-70	25-40	5-20
687---------- Watkins	0-12	Silt loam--------	CL, CL-ML	A-6, A-4	0	100	100	95-100	85-95	25-35	5-15
	12-44	Silty clay loam, silt loam.	CL, ML	A-6, A-7	0	100	100	95-100	85-95	35-45	10-20
	44-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	95-100	85-95	30-40	10-20
688---------- Koszta	0-15	Silt loam--------	CL	A-6	0	100	100	95-100	95-100	30-40	10-20
	15-60	Silty clay loam	CL	A-7	0	100	100	95-100	95-100	40-50	20-30
792D2---------- Armstrong	0-14	Loam----------	CL, CL-ML	A-6, A-4	0-5	90-100	80-95	75-90	55-80	20-30	5-15
	14-37	Clay loam, clay, silty clay loam.	CL, CH	A-7	0-5	90-100	80-95	70-90	55-80	45-60	20-30
	37-60	Clay loam--------	CL	A-6	0-5	90-100	80-95	70-90	55-80	30-40	15-20
822D2, 822E2----- Lamoni	0-10	Silty clay loam	CL	A-6, A-7	0	95-100	95-100	80-95	70-95	35-45	15-25
	10-50	Clay loam, clay	CH	A-7	0	95-100	95-100	90-100	85-100	50-60	25-35
	50-60	Clay loam--------	CL	A-6, A-7	0	95-100	95-100	70-90	55-85	35-50	15-30
876B, 876C2----- Ladoga	0-11	Silt loam--------	CL, CL-ML	A-6, A-4	0	100	100	100	95-100	25-40	5-15
	11-50	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	100	95-100	40-55	25-35
	50-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	100	95-100	30-40	15-20
881B, 881C2----- Otley	0-17	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	15-25
	17-37	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	100	95-100	40-55	25-35
	37-60	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-45	20-30
993D2*, 993E2*:											
Gara----------	0-11	Loam----------	CL, CL-ML	A-4, A-6	0	95-100	85-95	75-85	55-70	20-30	5-15
	11-43	Clay loam--------	CL	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	43-60	Loam, clay loam	CL	A-6, A-7	0-5	90-95	85-95	70-85	55-75	35-45	15-25
Armstrong-------	0-14	Loam----------	CL, CL-ML	A-6, A-4	0-5	90-100	80-95	75-90	55-80	20-30	5-15
	14-37	Clay loam, clay, silty clay loam.	CL, CH	A-7	0-5	90-100	80-95	70-90	55-80	45-60	20-30
	37-60	Clay loam--------	CL	A-6	0-5	90-100	80-95	70-90	55-80	30-40	15-20
1220*:											
Nodaway---------	0-38	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-35	5-15
	38-60	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-45	15-25
Ackmore---------	0-25	Silt 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, MH, ML	A-7, A-6	0	100	100	95-100	85-100	35-60	15-30

See footnotes 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	
5030*. Quarries											
5040*. Orthents											

* See description of the map unit for composition and behavior characteristics of the map unit.

** NP means nonplastic.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less 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		Wind erodibility group
								K	T	
	In	Pct	G/cm³	In/hr	In/in	pH				
5*:										
Ackmore	0-25	25-30	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate	0.37	5	6
	25-60	26-35	1.30-1.40	0.6-2.0	0.18-0.20	5.6-7.8	High	0.37		
Colo	0-17	27-32	1.28-1.32	0.6-2.0	0.21-0.23	5.6-7.3	High	0.28	5	7
	17-60	30-35	1.25-1.35	0.6-2.0	0.18-0.20	6.1-7.3	High	0.28		
7	0-21	24-32	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	Moderate	0.32	5	7
Wiota	21-48	30-36	1.30-1.40	0.6-2.0	0.18-0.20	5.1-6.5	Moderate	0.43		
	48-60	28-34	1.40-1.45	0.6-2.0	0.18-0.20	5.6-6.5	Moderate	0.43		
8B, 8C	0-33	25-32	1.30-1.35	0.6-2.0	0.21-0.23	6.1-7.3	Moderate	0.28	5	7
Judson	33-60	25-32	1.35-1.45	0.6-2.0	0.21-0.23	6.1-7.8	Moderate	0.43		
11B*:										
Colo	0-17	27-32	1.28-1.32	0.6-2.0	0.21-0.23	5.6-7.3	High	0.28	5	7
	17-60	30-35	1.25-1.35	0.6-2.0	0.18-0.20	6.1-7.3	High	0.28		
Ely	0-22	25-30	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	Moderate	0.32	5	7
	22-60	28-32	1.30-1.40	0.6-2.0	0.18-0.20	6.1-7.3	Moderate	0.43		
20C, 20C2, 20D2--	0-9	28-33	1.30-1.35	0.6-2.0	0.21-0.23	6.6-7.3	Moderate	0.32	5	7
Killduff	9-46	32-35	1.35-1.40	0.6-2.0	0.18-0.20	6.1-7.3	Moderate	0.43		
	46-60	26-32	1.40-1.45	0.6-2.0	0.20-0.22	6.6-7.3	Moderate	0.43		
24D2, 24E, 24E2, 24F	0-7	24-27	1.50-1.55	0.6-2.0	0.20-0.22	5.6-7.3	Moderate	0.28	5	6
Shelby	7-52	30-35	1.55-1.75	0.2-0.6	0.16-0.18	5.6-7.8	Moderate	0.28		
	52-60	30-35	1.75-1.85	0.2-0.6	0.16-0.18	6.6-8.4	Moderate	0.37		
41C, 41D	0-34	3-10	1.20-1.40	2.0-6.0	0.09-0.12	5.1-7.3	Low	0.17	5	2
Sparta	34-60	0-5	1.50-1.70	6.0-20	0.04-0.07	5.1-6.0	Low	0.17		
43	0-16	25-32	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate	0.28	5	7
Bremer	16-50	35-42	1.30-1.40	0.2-0.6	0.15-0.17	6.1-7.3	High	0.28		
	50-60	32-38	1.40-1.45	0.2-0.6	0.18-0.20	6.1-7.3	High	0.28		
51	0-17	20-26	1.30-1.35	0.6-2.0	0.20-0.24	5.6-7.3	Moderate	0.32	5	7
Vesser	17-32	16-22	1.35-1.40	0.6-2.0	0.18-0.22	5.1-6.0	Moderate	0.43		
	32-60	30-36	1.40-1.45	0.6-2.0	0.17-0.21	5.6-6.5	Moderate	0.43		
54	0-24	32-38	1.30-1.35	0.2-0.6	0.21-0.23	5.6-7.3	High	0.28	5	7
Zook	24-60	36-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.8	High	0.28		
65D, 65E	0-9	18-27	1.20-1.40	0.6-2.0	0.16-0.18	4.5-7.3	Low	0.32	5	6
Lindley	9-48	25-35	1.50-1.75	0.2-0.6	0.14-0.18	4.5-6.5	Moderate	0.32		
	48-60	18-32	1.75-1.85	0.2-0.6	0.12-0.16	6.1-7.8	Moderate	0.32		
65E3*	0-9	27-35	1.30-1.40	0.2-0.6	0.14-0.18	4.5-6.0	Moderate	0.32	4	6
Lindley	9-48	25-35	1.50-1.75	0.2-0.6	0.14-0.18	4.5-6.5	Moderate	0.32		
	48-60	18-32	1.75-1.85	0.2-0.6	0.12-0.16	6.1-7.8	Moderate	0.32		
65F	0-9	18-27	1.20-1.40	0.6-2.0	0.16-0.18	4.5-7.3	Low	0.32	5	6
Lindley	9-48	25-35	1.50-1.75	0.2-0.6	0.14-0.18	4.5-6.5	Moderate	0.32		
	48-60	18-32	1.75-1.85	0.2-0.6	0.12-0.16	6.1-7.8	Moderate	0.32		
65F3*	0-9	27-35	1.30-1.40	0.2-0.6	0.14-0.18	4.5-6.0	Moderate	0.32	4	6
Lindley	9-48	25-35	1.50-1.75	0.2-0.6	0.14-0.18	4.5-6.5	Moderate	0.32		
	48-60	18-32	1.75-1.85	0.2-0.6	0.12-0.16	6.1-7.8	Moderate	0.32		
65G	0-9	18-27	1.20-1.40	0.6-2.0	0.16-0.18	4.5-7.3	Low	0.32	5	6
Lindley	9-48	25-35	1.50-1.75	0.2-0.6	0.14-0.18	4.5-6.5	Moderate	0.32		
	48-60	18-32	1.75-1.85	0.2-0.6	0.12-0.16	6.1-7.8	Moderate	0.32		

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF 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/cm³	In/hr	In/in	pH				
75----------	0-16	18-26	1.30-1.40	0.6-2.0	0.22-0.24	5.6-6.0	Moderate-----	0.32	5	6
Givin	16-37	36-42	1.30-1.45	0.2-0.6	0.18-0.20	5.1-5.5	Moderate-----	0.43		
	37-60	27-34	1.40-1.50	0.2-0.6	0.18-0.20	5.1-6.0	Moderate-----	0.43		
76B, 76C, 76C2, 76D, 76D2-------	0-11	18-27	1.30-1.35	0.6-2.0	0.22-0.24	6.1-7.3	Low----------	0.32	5	6
Ladoga	11-50	36-42	1.30-1.40	0.2-0.6	0.18-0.20	5.1-6.0	Moderate-----	0.43		
	50-60	24-32	1.35-1.45	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.43		
80C, 80C2, 80D, 80D2, 80E2------	0-10	16-26	1.30-1.40	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.37	5	6
Clinton	10-60	36-42	1.35-1.45	0.2-0.6	0.16-0.20	5.1-6.0	Moderate-----	0.37		
88----------	0-19	26-29	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	7
Nevin	19-51	30-35	1.30-1.40	0.6-2.0	0.18-0.20	6.1-6.5	Moderate-----	0.43		
	51-60	25-36	1.40-1.45	0.6-2.0	0.18-0.20	6.6-7.3	Moderate-----	0.43		
93D2*, 93E2*:										
Shelby----------	0-7	24-27	1.50-1.55	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.28	5	6
	7-52	30-35	1.55-1.75	0.2-0.6	0.16-0.18	5.6-7.8	Moderate-----	0.28		
	52-60	30-35	1.75-1.85	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	2	6
	8-42	38-50	1.50-1.60	0.06-0.2	0.13-0.16	5.1-6.5	High---------	0.32		
	42-60	30-38	1.60-1.85	0.2-0.6	0.14-0.16	5.6-7.8	Moderate-----	0.32		
118----------	0-18	30-35	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	High---------	0.28	5	7
Garwin	18-54	28-34	1.28-1.35	0.6-2.0	0.18-0.20	6.1-7.3	High---------	0.28		
	54-60	20-26	1.35-1.45	0.6-2.0	0.20-0.22	6.6-7.8	Moderate-----	0.28		
119----------	0-17	28-30	1.30-1.35	0.6-2.0	0.22-0.24	5.1-7.3	Moderate-----	0.28	5	6
Muscatine	17-41	30-34	1.28-1.35	0.6-2.0	0.18-0.20	5.1-7.3	Moderate-----	0.43		
	41-60	22-26	1.35-1.40	0.6-2.0	0.18-0.20	6.0-7.8	Moderate-----	0.43		
120, 120B, 120C, 120C2, 120D2----	0-18	24-29	1.25-1.30	0.6-2.0	0.22-0.24	5.1-7.3	Moderate-----	0.32	5	7
Tama	18-46	28-34	1.30-1.35	0.6-2.0	0.18-0.20	5.1-6.0	Moderate-----	0.43		
	46-60	22-28	1.35-1.40	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43		
122----------	0-18	18-22	1.35-1.40	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.28	5	6
Sperry	18-50	38-45	1.40-1.45	0.06-0.2	0.14-0.16	5.1-6.5	High---------	0.43		
	50-60	26-34	1.45-1.50	0.2-0.6	0.19-0.21	5.6-6.5	High---------	0.43		
133----------	0-17	27-32	1.28-1.32	0.6-2.0	0.21-0.23	5.6-7.3	High---------	0.28	5	7
Colo	17-60	30-35	1.25-1.35	0.6-2.0	0.18-0.20	6.1-7.3	High---------	0.28		
133+----------	0-8	20-26	1.25-1.30	0.6-2.0	0.22-0.24	6.6-7.3	Moderate-----	0.28	5	6
Colo	8-26	30-35	1.25-1.35	0.6-2.0	0.18-0.20	6.1-7.3	High---------	0.28		
	26-60	30-35	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	High---------	0.28		
162B, 162C2, 162D, 162D2-----	0-11	18-24	1.25-1.30	0.6-2.0	0.21-0.23	5.1-7.3	Low----------	0.32	5	6
Downs	11-60	26-34	1.30-1.35	0.6-2.0	0.18-0.20	4.5-6.0	Moderate-----	0.43		
163C, 163C2, 163D2, 163E2----	0-12	15-25	1.30-1.35	0.6-2.0	0.20-0.22	5.1-7.3	Low----------	0.37	5	6
Fayette	12-60	30-35	1.30-1.45	0.6-2.0	0.18-0.20	4.5-6.0	Moderate-----	0.37		
179D, 179D2, 179E, 179E2, 179F----------	0-11	24-27	1.50-1.55	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.28	5	6
Gara	11-43	30-38	1.55-1.75	0.2-0.6	0.16-0.18	4.5-6.5	Moderate-----	0.28		
	43-60	24-38	1.75-1.85	0.2-0.6	0.16-0.18	6.6-7.8	Moderate-----	0.37		
192D2----------	0-8	27-35	1.45-1.50	0.2-0.6	0.17-0.19	5.6-7.3	Moderate-----	0.32	2	6
Adair	8-42	38-50	1.50-1.60	0.06-0.2	0.13-0.16	5.1-6.5	High---------	0.32		
	42-60	30-38	1.60-1.85	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 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/cm^3	In/hr	In/in	pH				
220----------	0-38	18-27	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Moderate-----	0.37	5	6
Nodaway	38-60	28-35	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.37		
222C, 222C2, 222D2----------	0-10	30-38	1.45-1.50	0.2-0.6	0.17-0.19	5.1-7.3	Moderate-----	0.37	3	7
Clarinda	10-60	40-60	1.45-1.60	<0.06	0.14-0.16	5.1-6.5	High---------	0.37		
273B, 273C-------	0-16	24-30	1.40-1.45	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.28	5	6
Olmitz	16-60	28-34	1.45-1.55	0.6-2.0	0.15-0.17	5.1-6.5	Moderate-----	0.28		
279----------	0-17	30-36	1.30-1.40	0.2-0.6	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7
Taintor	17-40	35-44	1.30-1.45	0.2-0.6	0.14-0.18	5.6-6.5	High---------	0.43		
	40-60	24-34	1.40-1.50	0.6-2.0	0.18-0.20	6.1-7.8	Moderate-----	0.43		
280----------	0-20	20-32	1.30-1.40	0.6-2.0	0.21-0.23	5.1-7.3	Moderate-----	0.32	5	7
Mahaska	20-40	36-42	1.30-1.45	0.6-2.0	0.14-0.18	4.5-6.0	Moderate-----	0.43		
	40-60	24-32	1.40-1.45	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43		
281B, 281C, 281C2, 281D2----	0-17	28-34	1.25-1.35	0.6-2.0	0.21-0.23	5.1-7.3	Moderate-----	0.32	5	7
Otley	17-37	34-42	1.30-1.40	0.6-2.0	0.18-0.20	5.1-6.0	Moderate-----	0.43		
	37-60	24-35	1.35-1.45	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43		
291----------	0-15	20-26	1.20-1.35	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.32	5	6
Atterberry	15-54	25-35	1.30-1.50	0.6-2.0	0.18-0.20	5.1-6.0	Moderate-----	0.43		
	54-60	20-30	1.35-1.55	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.43		
293D2*, 293E2*, 293F*:										
Chelsea--------	0-19	8-15	1.50-1.55	6.0-20	0.10-0.15	5.6-7.3	Low----------	0.17	5	2
	19-60	5-10	1.55-1.70	6.0-20	0.06-0.08	5.1-5.5	Low----------	0.17		
Ladoga---------	0-11	18-27	1.30-1.35	0.6-2.0	0.22-0.24	6.1-7.3	Low----------	0.32	5	6
	11-50	36-42	1.30-1.40	0.2-0.6	0.18-0.20	5.1-6.0	Moderate-----	0.43		
	50-60	24-32	1.35-1.45	0.6-2.0	0.18-0.20	5.1-7.3	Moderate-----	0.43		
377C2, 377D2-----	0-6	25-29	1.25-1.30	0.6-2.0	0.21-0.23	5.1-7.3	Moderate-----	0.32	5	7
Dinsdale	6-27	30-34	1.30-1.35	0.6-2.0	0.18-0.20	5.1-7.3	Moderate-----	0.43		
	27-60	20-28	1.65-1.80	0.6-2.0	0.17-0.19	5.6-8.4	Low----------	0.43		
422----------	0-15	18-30	1.20-1.30	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.37	5	6
Amana	15-55	18-30	1.25-1.40	0.6-2.0	0.20-0.22	5.1-6.5	Moderate-----	0.37		
	55-60	18-26	1.25-1.40	0.6-2.0	0.20-0.22	5.6-6.5	Moderate-----	0.37		
424D2*:										
Lindley---------	0-9	18-27	1.20-1.40	0.6-2.0	0.16-0.18	4.5-7.3	Low----------	0.32	5	6
	9-48	25-35	1.50-1.75	0.2-0.6	0.14-0.18	4.5-6.5	Moderate-----	0.32		
	48-60	18-32	1.75-1.85	0.2-0.6	0.12-0.16	6.1-7.8	Moderate-----	0.32		
Keswick---------	0-9	22-27	1.45-1.50	0.6-2.0	0.17-0.22	4.5-7.3	Moderate-----	0.37	3	6
	9-30	35-48	1.45-1.60	0.06-0.2	0.11-0.15	4.5-6.0	High---------	0.37		
	30-60	30-48	1.60-1.80	0.2-0.6	0.12-0.16	4.5-6.0	Moderate-----	0.37		
425D2----------	0-9	22-27	1.45-1.50	0.6-2.0	0.17-0.22	4.5-7.3	Moderate-----	0.37	3	6
Keswick	9-30	35-48	1.45-1.60	0.06-0.2	0.11-0.15	4.5-6.0	High---------	0.37		
	30-60	30-48	1.60-1.80	0.2-0.6	0.12-0.16	4.5-6.0	Moderate-----	0.37		
428B----------	0-22	25-30	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	7
Ely	22-60	28-32	1.30-1.40	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
430----------	0-25	25-30	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.37	5	6
Ackmore	25-60	26-35	1.30-1.40	0.6-2.0	0.18-0.20	5.6-7.8	High---------	0.37		
442E2*:										
Downs----------	0-11	18-24	1.25-1.30	0.6-2.0	0.21-0.23	5.1-7.3	Low----------	0.32	5	6
	11-60	26-34	1.30-1.35	0.6-2.0	0.18-0.20	4.5-6.0	Moderate-----	0.43		

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF 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/cm^3	In/hr	In/in	pH				
442E2*:										
Chelsea	0-19	8-15	1.50-1.55	6.0-20	0.10-0.15	5.6-7.3	Low	0.17	5	2
	19-60	5-10	1.55-1.70	6.0-20	0.06-0.08	5.1-7.3	Low	0.17		
451D2	0-6	22-30	1.45-1.50	0.6-2.0	0.14-0.18	4.5-7.3	Low	0.28	5	6
Caleb	6-26	20-35	1.45-1.65	0.6-2.0	0.14-0.18	4.5-6.0	Moderate	0.28		
	26-60	5-30	1.55-1.75	0.6-6.0	0.12-0.16	5.5-6.5	Low	0.28		
453	0-17	16-22	1.35-1.40	0.6-2.0	0.19-0.23	5.1-7.3	Moderate	0.32	3	7
Tuskeego	17-41	32-48	1.30-1.45	<0.06	0.13-0.17	5.1-6.0	High	0.32		
	41-60	28-40	1.40-1.50	0.06-0.2	0.16-0.19	5.6-6.5	Moderate	0.32		
462B, 462C2	0-11	18-24	1.25-1.30	0.6-2.0	0.21-0.23	5.1-7.3	Low	0.32	5	6
Downs	11-60	26-34	1.30-1.35	0.6-2.0	0.18-0.20	4.5-6.0	Moderate	0.43		
484	0-30	10-20	1.20-1.55	0.6-2.0	0.22-0.24	6.1-7.8	Low	0.32	5	5
Lawson	30-60	18-30	1.55-1.65	0.6-2.0	0.18-0.20	6.1-7.8	Moderate	0.43		
488C2, 488D2	0-6	22-26	1.25-1.30	0.6-2.0	0.20-0.22	6.6-7.3	Moderate	0.32	4	6
Downs Variant	6-33	27-35	1.30-1.35	0.6-2.0	0.18-0.20	6.1-7.3	Moderate	0.43		
	33-60	20-26	1.35-1.45	0.6-2.0	0.18-0.20	6.6-7.3	Moderate	0.43		
570C2, 570D2	0-7	28-34	1.25-1.40	0.6-2.0	0.21-0.23	5.6-7.3	Moderate	0.32	5	7
Nira	7-44	30-35	1.25-1.40	0.6-2.0	0.18-0.20	5.1-6.5	Moderate	0.43		
	44-60	24-34	1.35-1.45	0.6-2.0	0.18-0.20	5.6-7.3	Moderate	0.43		
571C2, 571D2	0-7	27-34	1.30-1.35	0.6-2.0	0.20-0.22	5.6-7.3	Moderate	0.32	4	7
Hedrick	7-50	27-37	1.30-1.45	0.6-2.0	0.18-0.20	5.1-6.5	Moderate	0.43		
	50-60	24-32	1.40-1.45	0.6-2.0	0.18-0.20	5.6-7.8	Moderate	0.43		
592D2	0-5	22-35	1.45-1.50	0.6-2.0	0.22-0.24	4.5-7.3	Moderate	0.37	3	6
Mystic	5-29	30-48	1.45-1.75	0.06-0.2	0.15-0.19	4.5-6.5	High	0.37		
	29-61	20-35	1.55-1.75	0.6-2.0	0.16-0.18	4.5-6.5	Moderate	0.37		
683D2	0-8	20-25	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.32	5	6
Liscomb	8-46	20-28	1.45-1.65	0.6-2.0	0.17-0.19	5.6-7.3	Low	0.32		
	46-60	20-24	1.65-1.80	0.6-2.0	0.15-0.17	6.1-7.8	Low	0.32		
687	0-12	18-24	1.30-1.35	0.6-2.0	0.20-0.24	5.6-7.3	Moderate	0.32	5	7
Watkins	12-44	25-35	1.35-1.40	0.6-2.0	0.15-0.19	5.1-6.5	Moderate	0.43		
	44-60	25-32	1.40-1.45	0.6-2.0	0.14-0.18	5.6-6.5	Moderate	0.43		
688	0-15	18-24	1.30-1.40	0.6-2.0	0.20-0.24	5.6-7.3	Moderate	0.32	5	7
Koszta	15-60	28-35	1.30-1.45	0.6-2.0	0.15-0.19	5.1-7.3	Moderate	0.43		
792D2	0-14	22-27	1.45-1.50	0.6-2.0	0.20-0.22	5.6-7.3	Moderate	0.32	3	6
Armstrong	14-37	36-48	1.45-1.55	0.06-0.2	0.11-0.16	4.5-6.5	High	0.32		
	37-60	30-36	1.55-1.75	0.2-0.6	0.14-0.16	5.1-6.5	Moderate	0.32		
822D2, 822E2	0-10	27-38	1.45-1.50	0.2-0.6	0.17-0.21	5.1-7.3	Moderate	0.32	2	7
Lamoni	10-50	38-50	1.55-1.75	<0.2	0.13-0.17	5.1-7.3	High	0.32		
	50-60	32-40	1.75-1.85	0.06-0.2	0.14-0.18	6.1-7.3	High	0.32		
876B, 876C2	0-11	18-27	1.30-1.35	0.6-2.0	0.22-0.24	6.1-7.3	Low	0.32	5	6
Ladoga	11-50	36-42	1.30-1.40	0.2-0.6	0.18-0.20	5.1-6.0	Moderate	0.43		
	50-60	24-32	1.35-1.45	0.6-2.0	0.18-0.20	5.1-6.5	Moderate	0.43		
881B, 881C2	0-17	28-34	1.25-1.35	0.6-2.0	0.21-0.23	5.1-7.3	Moderate	0.32	5	7
Otley	17-37	34-42	1.30-1.40	0.6-2.0	0.18-0.20	5.1-5.5	Moderate	0.43		
	37-60	24-35	1.35-1.45	0.6-2.0	0.18-0.20	5.6-7.3	Moderate	0.43		
993D2*, 993E2*:										
Gara	0-11	24-27	1.50-1.55	0.6-2.0	0.20-0.22	5.6-7.3	Moderate	0.28	5	6
	11-43	30-38	1.55-1.75	0.2-0.6	0.16-0.18	4.5-6.5	Moderate	0.28		
	43-60	24-38	1.75-1.85	0.2-0.6	0.16-0.18	6.6-7.8	Moderate	0.37		

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF 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/cm³	In/hr	In/in	pH				
993D2*, 993E2*:										
Armstrong-------	0-14	22-27	1.45-1.50	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.32	3	6
	14-37	36-48	1.45-1.55	0.06-0.2	0.11-0.16	4.5-6.5	High---------	0.32		
	37-60	30-36	1.55-1.75	0.2-0.6	0.14-0.16	5.1-6.5	Moderate-----	0.32		
1220*:										
Nodaway---------	0-38	18-27	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Moderate-----	0.37	5	6
	38-60	28-35	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.37		
Ackmore---------	0-25	25-30	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.37	5	6
	25-60	26-35	1.30-1.40	0.6-2.0	0.18-0.20	5.6-7.8	High---------	0.37		
5030*. Quarries										
5040*. Orthents										

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

[The definitions of "flooding" and "water table" in the text explain terms such as "rare," "brief," "apparent," and "perched." The symbol > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
5*: Ackmore	B	Frequent	Very brief to brief.	Sep-Jun	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Low.
Colo	B/D	Frequent	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
7---------- Wiota	B	Rare	---	---	>6.0	---	---	>60	---	High	Moderate	Moderate.
8B, 8C---------- Judson	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Low.
11B*: Colo	B/D	Frequent	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
Ely	B	None	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
20C, 20C2, 20D2--- Killduff	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Moderate.
24D2, 24E, 24E2, 24F---------- Shelby	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
41C, 41D---------- Sparta	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
43---------- Bremer	C	Rare	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	High	Moderate	Moderate.
51---------- Vesser	C	Occasional	Brief	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
54---------- Zook	C/D	Occasional	Brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-May	>60	---	High	High	Moderate.
65D, 65E, 65E3*, 65F, 65F3*, 65G-- Lindley	C	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
75---------- Givin	C	None	---	---	2.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
76B, 76C, 76C2, 76D, 76D2-------- Ladoga	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.

See footnotes at end of

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
80C, 80C2, 80D, 80D2, 80E2---- Clinton	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
88---- Nevin	B	Rare	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High	High	Low.
93D2*, 93E2*: Shelby----	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
Adair----	D	None	---	---	1.0-3.0	Perched	Nov-Jul	>60	---	High	High	Moderate.
118---- Garwin	B/D	None	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
119---- Muscatine	B	None	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
120, 120B, 120C, 120C2, 120D2---- Tama	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Moderate.
122**---- Sperry	C/D	None	---	---	+1-1.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
133---- Colo	B/D	Occasional	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
133+---- Colo	B/D	Frequent	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
162B, 162C2, 162D, 162D2---- Downs	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Moderate.
163C, 163C2, 163D2, 163E2---- Fayette	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Moderate.
179D, 179D2, 179E, 179E2, 179F---- Gara	C	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
192D2---- Adair	D	None	---	---	1.0-3.0	Perched	Nov-Jul	>60	---	High	High	Moderate.
220---- Nodaway	B	Occasional	Very brief to brief.	Feb-Nov	3.0-5.0	Apparent	Apr-Jul	>60	---	High	Moderate	Low.
222C, 222C2, 222D2---- Clarinda	D	None	---	---	1.0-3.0	Perched	Nov-Jul	>60	---	High	High	Moderate.

See footnotes at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
273B, 273C---------- Olmitz	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
279---------- Taintor	C/D	None---------	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
280---------- Mahaska	B	None---------	---	---	2.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
281B, 281C, 281C2, 281D2---------- Otley	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
291---------- Atterberry	B	None---------	---	---	1.0-3.0	Apparent	Mar-Jun	>60	---	High-----	High-----	Moderate.
293D2*, 293E2*, 293F*:												
Chelsea---------	A	None---------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
Ladoga----------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
377C2, 377D2------ Dinsdale	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
422---------- Amana	B	Occasional	Brief-----	Feb-Nov	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
424D2*:												
Lindley----------	C	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
Keswick----------	D	None---------	---	---	1.0-3.0	Perched	Nov-Jul	>60	---	High-----	High-----	Moderate.
425D2---------- Keswick	D	None---------	---	---	1.0-3.0	Perched	Nov-Jul	>60	---	High-----	High-----	Moderate.
428B---------- Ely	B	None---------	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
430---------- Ackmore	B	Frequent----	Very brief to brief.	Sep-Jun	1.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
442E2*:												
Downs----------	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
Chelsea----------	A	None---------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
451D2---------- Caleb	B	None---------	---	---	3.0-5.0	Perched	Nov-Mar	>60	---	Moderate	Moderate	Moderate.
453---------- Tuskeego	C/D	Rare---------	---	---	0-1.0	Apparent	Nov-Jul	>60	---	Moderate	High-----	Moderate.

See footnotes at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
462B, 462C2---- Downs	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Moderate.
484---- Lawson	C	Occasional	Brief	Mar-Nov	1.0-3.0	Apparent	Nov-May	>60	---	High	Moderate	Low.
488C2, 488D2---- Downs Variant	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Moderate.
570C2, 570D2---- Nira	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Moderate.
571C2, 571D2---- Hedrick	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Moderate.
592D2---- Mystic	D	None	---	---	3.0-5.0	Perched	Nov-Jul	>60	---	High	Moderate	Moderate.
683D2---- Liscomb	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
687---- Watkins	B	Rare	---	---	>6.0	---	---	>60	---	High	Moderate	Moderate.
688---- Koszta	B	Rare	---	---	2.0-3.0	Apparent	Nov-Jul	>60	---	High	Moderate	Moderate.
792D2---- Armstrong	D	None	---	---	1.0-3.0	Perched	Nov-Jul	>60	---	High	High	Moderate.
822D2, 822E2---- Lamoni	D	None	---	---	1.0-3.0	Perched	Nov-Jul	>60	---	Moderate	High	Moderate.
876B, 876C2---- Ladoga	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
881B, 881C2---- Otley	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
993D2*, 993E2*:												
Gara----	C	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
Armstrong----	D	None	---	---	1.0-3.0	Perched	Nov-Jul	>60	---	High	High	Moderate.
1220*:												
Nodaway----	B	Frequent	Very brief to brief.	Feb-Nov	3.0-5.0	Apparent	Apr-Jul	>60	---	High	Moderate	Low.
Ackmore----	B	Frequent	Very brief to brief.	Sep-Jun	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Low.
5030*. Quarries												

See footnotes at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
5040*. Orthents												

* See description of the map unit for composition and behavior characteristics of the map unit.

** A plus sign under "Depth to high water table" indicates that the water table is above the surface of the soil.

TABLE 18.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Ackmore	Fine-silty, mixed, nonacid, mesic Aeric Fluvaquents
Adair	Fine, montmorillonitic, mesic Aquic Argiudolls
Amana	Fine-silty, mixed, mesic Aquic Hapludolls
Armstrong	Fine, montmorillonitic, mesic Aquollic Hapludalfs
Atterberry	Fine-silty, mixed, mesic Udollic Ochraqualfs
Bremer	Fine, montmorillonitic, mesic Typic Argiaquolls
Caleb	Fine-loamy, mixed, mesic Mollic Hapludalfs
Chelsea	Mixed, mesic Alfic Udipsamments
Clarinda	Fine, montmorillonitic, mesic, sloping Typic Argiaquolls
Clinton	Fine, montmorillonitic, mesic Typic Hapludalfs
Colo	Fine-silty, mixed, mesic Cumulic Haplaquolls
*Dinsdale	Fine-silty, mixed, mesic Typic Argiudolls
Downs	Fine-silty, mixed, mesic Mollic Hapludalfs
Downs Variant	Fine-silty, mixed, mesic Mollic Hapludalfs
Ely	Fine-silty, mixed, mesic Cumulic Hapludolls
Fayette	Fine-silty, mixed, mesic Typic Hapludalfs
Gara	Fine-loamy, mixed, mesic Mollic Hapludalfs
Garwin	Fine-silty, mixed, mesic Typic Haplaquolls
Givin	Fine, montmorillonitic, mesic Udollic Ochraqualfs
Hedrick	Fine-silty, mixed, mesic Mollic Hapludalfs
Judson	Fine-silty, mixed, mesic Cumulic Hapludolls
Keswick	Fine, montmorillonitic, mesic Aquic Hapludalfs
Killduff	Fine-silty, mixed, mesic Dystric Eutrochrepts
Koszta	Fine-silty, mixed, mesic Udollic Ochraqualfs
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
*Liscomb	Fine-loamy, mixed, mesic Typic Hapludolls
Mahaska	Fine, montmorillonitic, mesic Aquic Argiudolls
Muscatine	Fine-silty, mixed, mesic Aquic Hapludolls
Mystic	Fine, montmorillonitic, mesic Aquollic Hapludalfs
Nevin	Fine-silty, mixed, mesic Aquic Argiudolls
*Nira	Fine-silty, mixed, mesic Typic Hapludolls
Nodaway	Fine-silty, mixed, nonacid, mesic Mollic Udifluvents
Olmitz	Fine-loamy, mixed, mesic Cumulic Hapludolls
Orthents	Loamy, mixed, mesic Typic Udorthents
Otley	Fine, montmorillonitic, mesic Typic Argiudolls
Shelby	Fine-loamy, mixed, mesic Typic Argiudolls
Sparta	Sandy, mixed, mesic Entic Hapludolls
Sperry	Fine, montmorillonitic, mesic Typic Argialbolls
Taintor	Fine, montmorillonitic, mesic Typic Argiaquolls
Tama	Fine-silty, mixed, mesic Typic Argiudolls
Tuskeego	Fine, montmorillonitic, mesic Mollic Ochraqualfs
Vesser	Fine-silty, mixed, mesic Argiaquic Argialbolls
Watkins	Fine-silty, mixed, mesic Mollic Hapludalfs
Wiota	Fine-silty, mixed, mesic Typic Argiudolls
Zook	Fine, montmorillonitic, mesic Cumulic Haplaquolls

* 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.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1981-346-609/1061