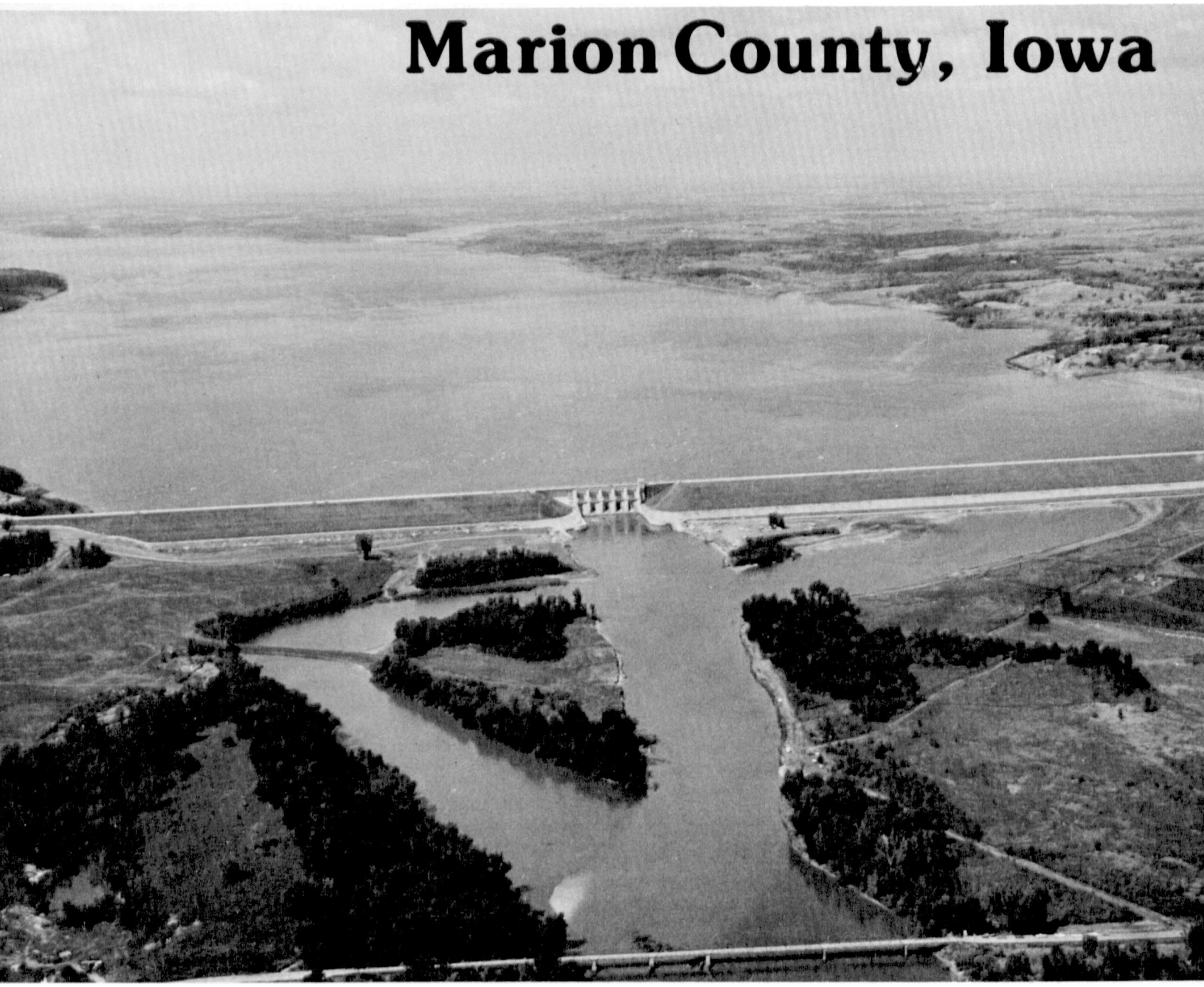
SOIL SURVEY OF

Marion 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
and the
Department of Soil Conservation, State of Iowa

HOW TO USE

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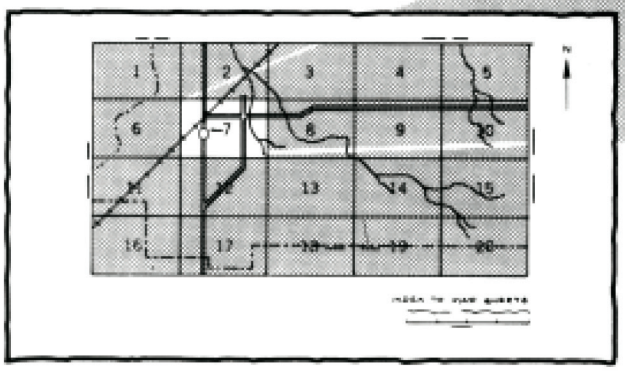

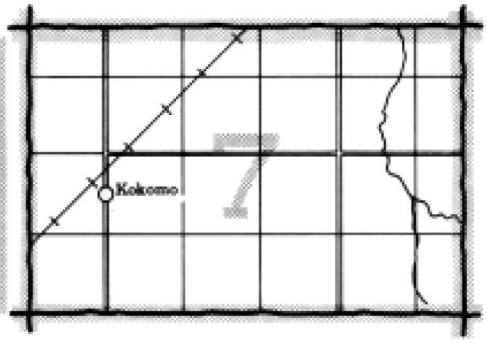

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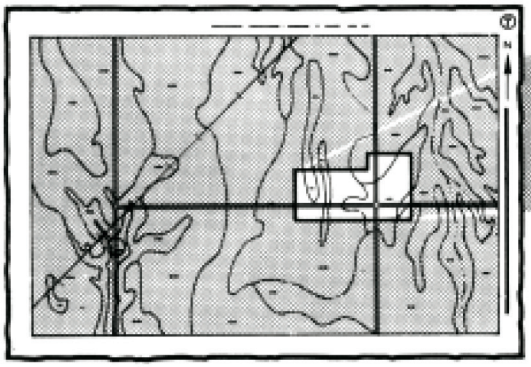

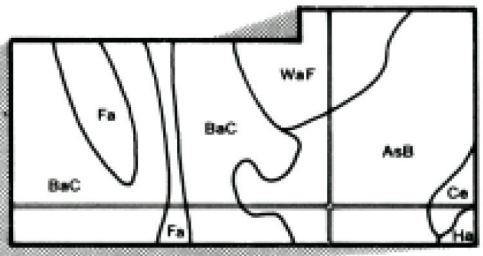

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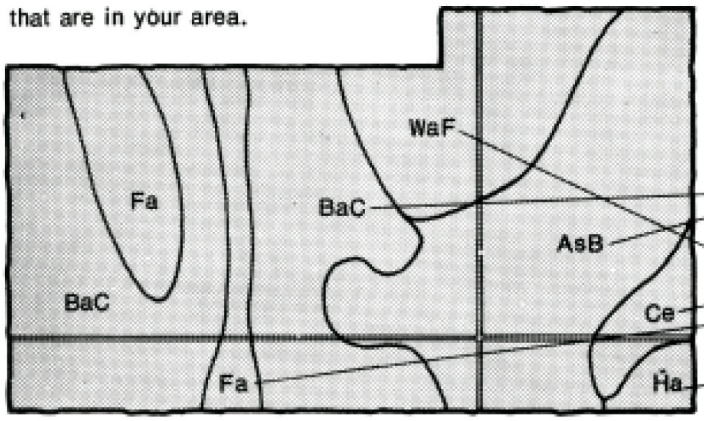

Symbols

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BaC
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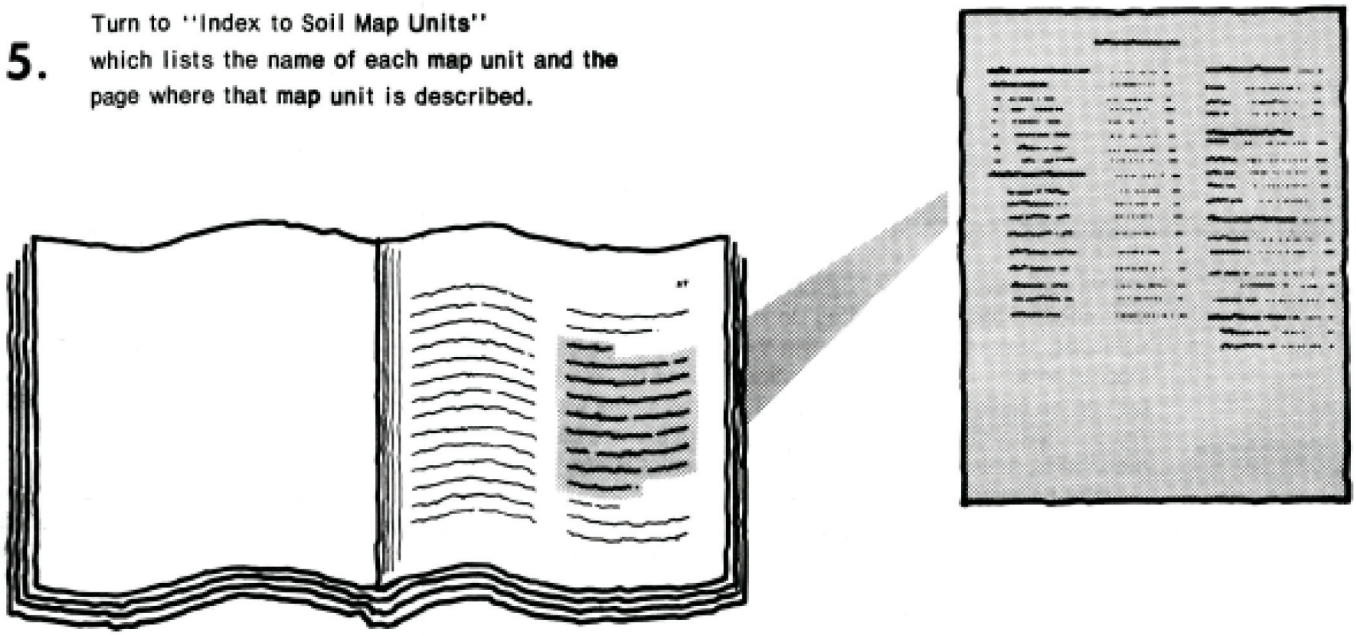
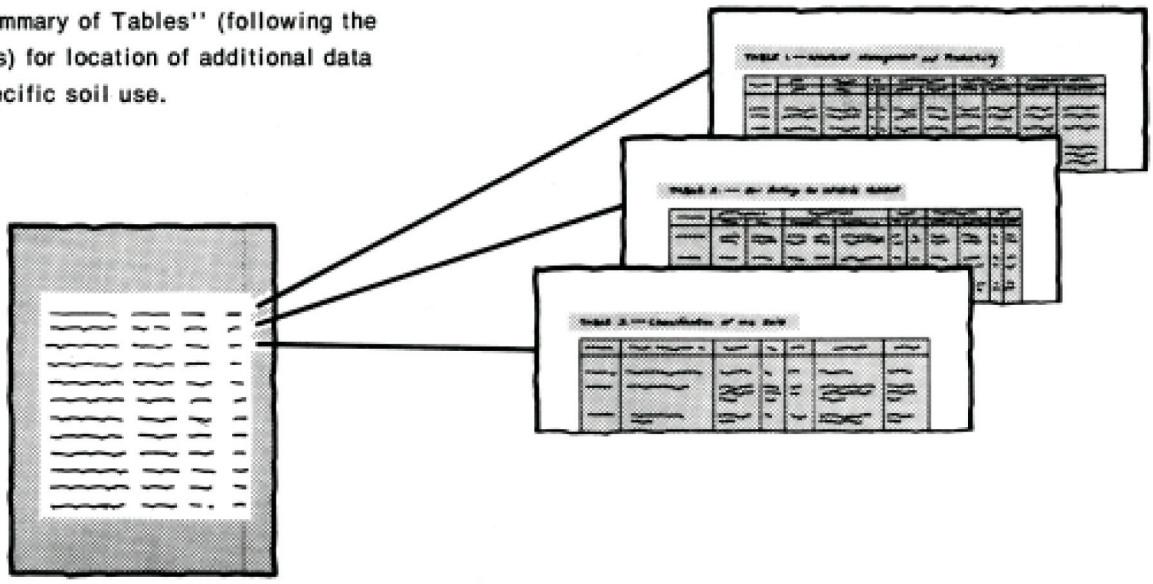
THIS SOIL SURVEY

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



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



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

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

Major fieldwork for this soil survey was performed in the period 1969-73. Soil names and descriptions were approved in June 1976. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1973. This survey was made cooperatively by the Soil Conservation Service and the Iowa Agriculture and Home Economics Experiment Station, 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 Marion County Soil Conservation District. Funds appropriated by Marion County were used to defray part of the cost of this survey.

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

Cover: Red Rock Lake and surrounding soils in Marion County.

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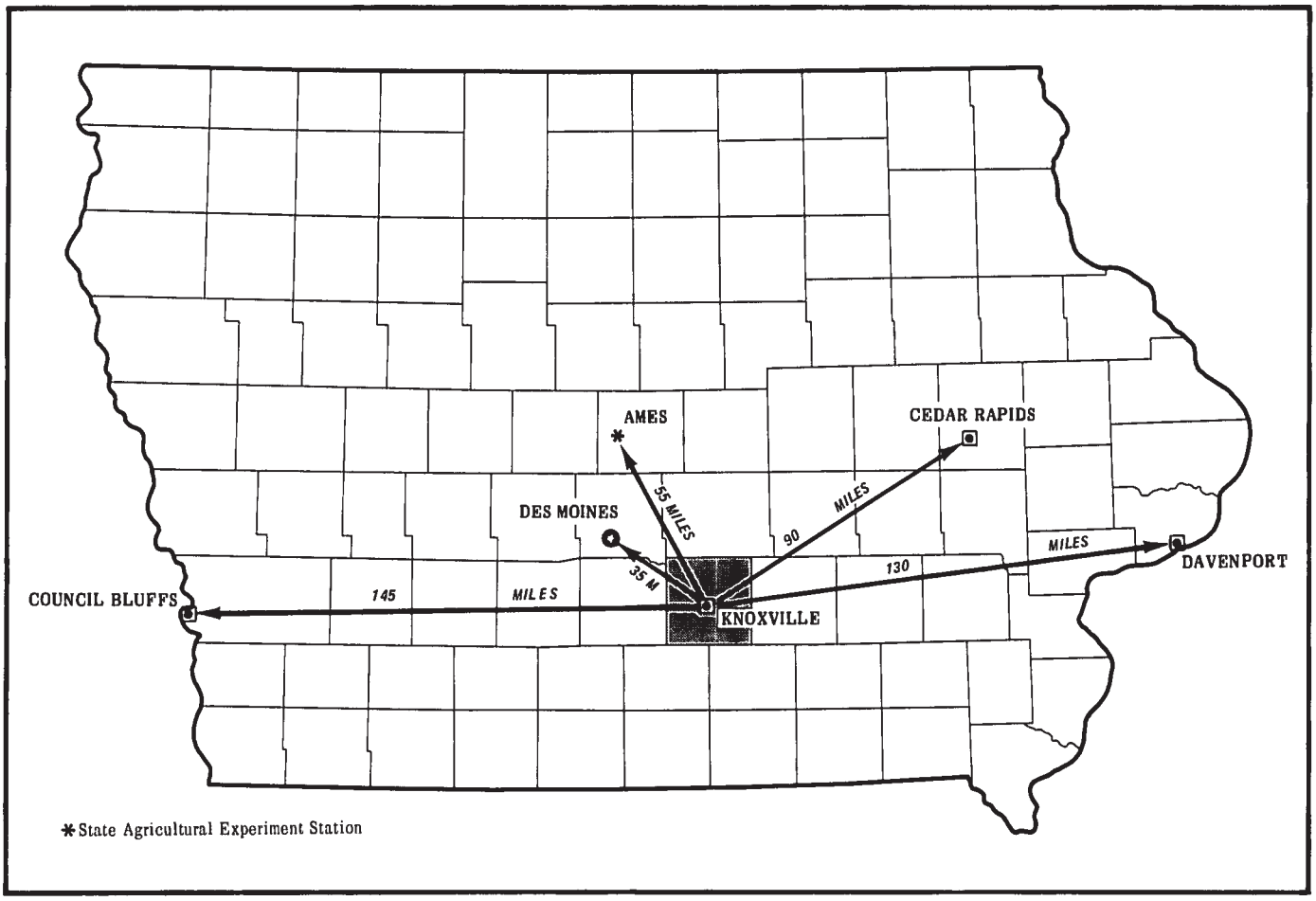
Preface

This soil survey contains information that can be used in land-planning programs in Marion County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to 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.



Location of Marion County in Iowa.

SOIL SURVEY OF MARION COUNTY, IOWA

By Robert C. Russell and L. Dale Lockridge, Soil Conservation Service

Fieldwork by Robert C. Russell, Robert O. Dideriksen, Robert C. Shuman, Douglas B. Oelmann, and James Clements, Soil Conservation Service

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

Marion County is in south-central Iowa. Knoxville, the county seat, is about 35 miles southeast of Des Moines. The county contains 16 townships and covers an area of 554 square miles, or about 354,570 acres.

The soils in bottom lands make up about 8 percent of the county, nearly level to gently undulating soils make up about 15 percent, and the rest is gently rolling to very steep soils on uplands. The soils in Marion County formed under prairie grasses, trees, or a combination of grasses and trees.

General nature of the county

This section describes the climate, landscape, and history of Marion County.

Climate

Marion County is cold in winter. In summer the county is generally quite hot but has occasional cool spells. Precipitation during the winter frequently occurs as snowstorms, and during the warm months precipitation falls chiefly as showers, often heavy showers, 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 Knoxville, 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 length of the growing season.

In winter the average temperature is 25 degrees F, and the average daily low is 16 degrees. The lowest temperature on record, -25 degrees, occurred at Knoxville on January 18, 1967. In summer the average temperature is 74 degrees, and the average daily high is 85 degrees. The highest temperature, 102 degrees, was recorded on June 29, 1970.

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, 24 inches, or 73 percent, falls during the period April through September, which includes the growing season for most crops. Two years in ten, the April-September rainfall is less than 18 inches. The heaviest 1-day rainfall during the period of record was 6.08 inches at Knoxville on November 17, 1952. Thunderstorms number about 50 each year; 25 occur in summer.

Average seasonal rainfall is 29 inches. The greatest snow depth at any one time during the period of record was 30 inches. On the average, 17 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 81 percent. The proportion of possible sunshine is 70 percent in summer and 50 percent in winter. The prevailing winds are 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 cause sparse damage in narrow belts. During the warmer part of the year hailstorms occur in irregular patterns and in relatively small areas.

Physiography and relief

Marion County is part of a broad plain into which the Des Moines and Skunk Rivers, and their numerous tributaries, have cut valleys. These streams divide the county into several upland areas which rise to about the same

general level and have similar topographic features. The streams have cut through successive layers of loess, glacial till, shale, and alluvium. Remnants of the orginal plain, which make up a comparatively small part of the county, remain as winding, nearly level upland divides one-quarter mile to 2 miles wide. The break from the stable summits toward the streams first takes the form of gentle slopes. At lower elevations the slopes generally become steeper, but the steepest slopes are found only close to the streams.

The highest elevation in the county, about 1,000 feet, is on an upland divide near the southwest corner of the county. The lowest, about 700 feet, is on the Des Moines River flood plain at the middle of the east border.

History and development

Before the county was opened to settlement in 1843, only a few white traders lived in this general region. The county was organized in 1845. The majority of early settlers came from eastern and southern states. During the eighties, about 800 immigrants from the Netherlands settled in the extreme northeastern part of the county and founded the town of Pella.

Knoxville, the county seat, has a population of 7,775. A large Federal hospital for disabled veterans is located here. Pella, the second most populated town, has 6,400 inhabitants. Central College is there. The total population of Marion County is 25,500.

Farming and related business are the chief sources of income in Marion County. Much of the county is in farms. Most farming operations are diversified. Cash grain farming is practiced in some areas. Corn, soybeans, hay, and pasture are the principal crops. Most of the grain and forage are fed to hogs and beef cattle that are raised in this county.

In 1969, the Red Rock Reservoir was completed by the U.S. Army Corps of Engineers. It is a flood control reservoir on the Des Moines River between Knoxville and Pella. The area of the conservation pool is 9,000 acres. The dam is more than 1 mile long.

Marion County has nearly 5,000 acres of strip mines, principally in the southern half of the county. Presently several strip mines are in operation. The coal vein averages 5 feet in thickness.

The Marion County Soil Conservation District was organized in 1941. It was the first conservation district established in Iowa.

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 for broad land use planning" and "Soil maps for detailed planning."

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 for broad land use planning

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each soil association on the general soil map is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in 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 select-

ing a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

1. Taintor-Mahaska association

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

This association is on upland divides that are 1/4 mile to 2 miles wide. This association covers about 5 percent of the county. It is about 40 percent Taintor soils, 40 percent Mahaska soils, and 20 percent minor soils (fig. 1).

Taintor soils are nearly level and poorly drained. They formed under prairie grasses. The surface layer is black and very dark gray silty clay loam about 19 inches thick. The subsoil is silty clay loam about 41 inches thick.

Mahaska soils are in slightly convex areas bordering the more nearly level Taintor soils. Mahaska soils are somewhat poorly drained. They formed under prairie grasses. The surface layer is black and very dark grayish brown silty clay loam about 19 inches thick. The subsoil is silty clay loam about 41 inches thick.

The minor soils in this association are Otley and Nira soils. Otley soils are moderately well drained and are gently sloping and moderately sloping. They are on upland ridges and side slopes. They formed under prairie grasses. Nira soils are moderately well drained and are gently sloping and moderately sloping. They are on convex side slopes.

Content of organic matter in the surface layer is moderate to high. Available water capacity is high.

The soils in this association are well suited to row crops and are used for row crops. Cash grain farming is the major enterprise, and general farming is practiced.

The main concern of management is improving drainage of the Taintor soils by using tile systems. Contour farming and terraces help to control erosion on the gently sloping soils.

A State highway is on the upland divide in this association.

2. Sharpsburg-Macksburg-Winterset association

Nearly level and gently sloping, moderately well drained to poorly drained soils that formed in loess on uplands

This soil association consists mostly of nearly level, stable ridge summits (fig. 2). The gently sloping soils are on convex shoulders that border the ridge summit. This association is on upland divides that are one-quarter mile to 2 miles wide. This association covers about 4 percent of the county. It is about 45 percent Sharpsburg soils, 35 percent Macksburg soils, 15 percent Winterset soils, and 5 percent minor soils.

Sharpsburg soils are gently sloping and moderately well drained. They formed under prairie grasses. The surface layer is very dark gray, dark brown, and very dark grayish brown silty clay loam about 17 inches thick. The subsoil is silty clay loam about 39 inches thick.

Macksburg soils are nearly level or gently sloping and are somewhat poorly drained. They formed under prairie grasses. The surface layer is black and very dark grayish brown silty clay loam about 24 inches thick. The subsoil is silty clay loam about 31 inches thick.

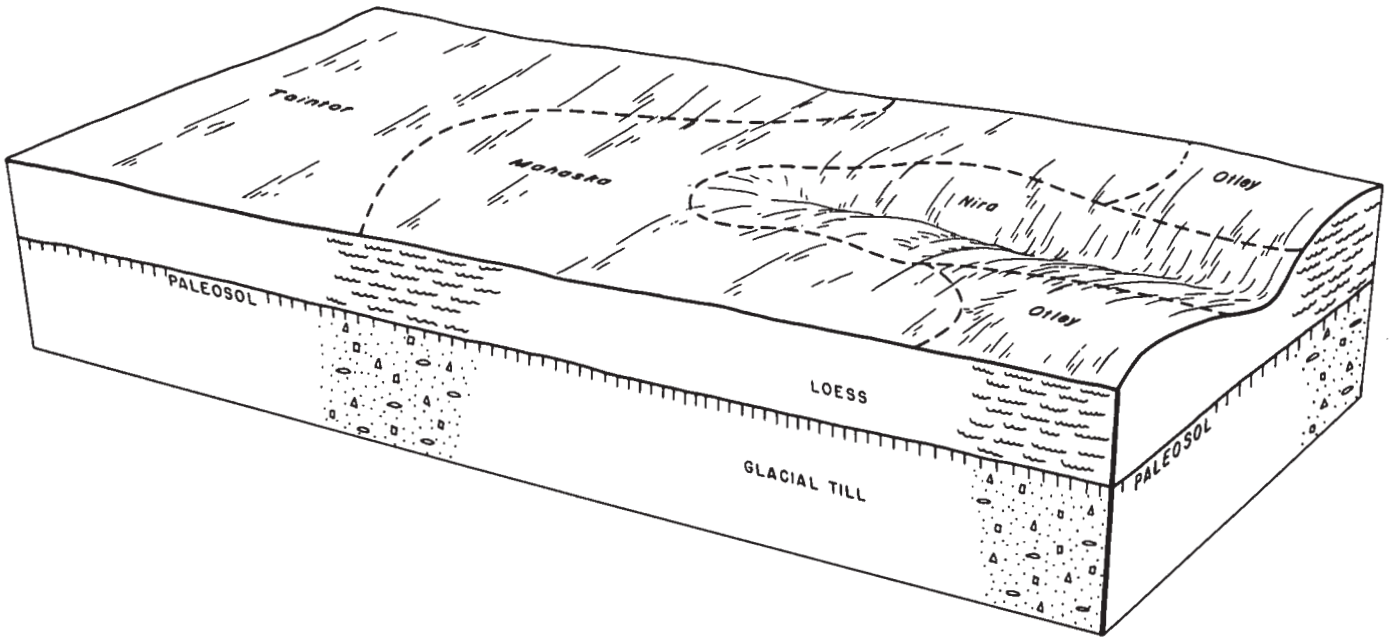


Figure 1.—Typical pattern of soils in the Taintor-Mahaska association.

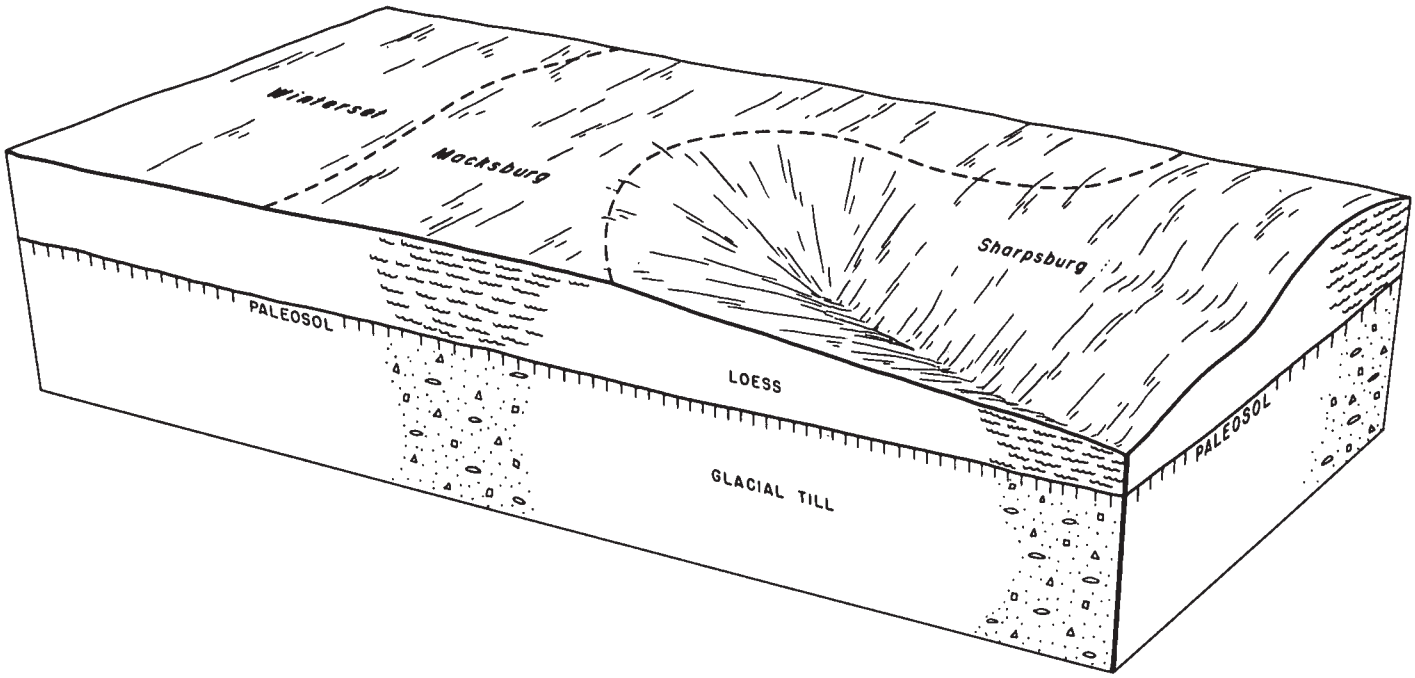


Figure 2.—Typical pattern of soils in the Sharpsburg-Macksburg-Winterset association.

Winterset soils are nearly level and poorly drained. They formed under prairie grasses. The surface layer is black and very dark gray silty clay loam about 16 inches thick. The subsoil is silty clay about 32 inches thick.

The minor soils in this association are Nira and Ladoga soils. Nira soils are moderately well drained and gently sloping. They are at the heads of drainageways. Ladoga soils are moderately well drained and are on convex shoulders that border the ridge summit.

Content of organic matter in the surface layer is high to moderate. Available water capacity is high.

The soils in this association are well suited to continuous row crops. Cash farming is the major enterprise, but farming is diversified. Corn and soybeans are grown intensively on the nearly level and gently sloping soils.

The main concerns of management are controlling water erosion and improving drainage. Contour farming controls erosion on the gently sloping soils.

Two State highways are on the upland divides in this association.

3. Arispe-Grundy-Haig association

Nearly level to moderately sloping, moderately well drained to poorly drained soils that formed in loess on uplands

This association consists mainly of nearly level soils on stable ridge summits and gently sloping or moderately sloping soils on convex shoulders that border the ridge summits. It is on upland divides that are one-quarter to a mile wide.

This association covers about 6 percent of the county. It is about 35 percent Arispe soils, 35 percent Grundy soils, 15 percent Haig soils, and 15 percent minor soils (fig. 3).

Arispe soils are moderately sloping and are moderately well drained and somewhat poorly drained. They formed under prairie grasses. The surface layer is very dark silty clay loam about 7 inches thick. The subsoil is silty clay loam about 38 inches thick.

Grundy soils are gently sloping and somewhat poorly drained. They formed under prairie grasses. The surface layer is very dark brown silty clay loam about 13 inches thick. The subsoil is silty clay and silty clay loam to a depth of 60 inches or more.

Haig soils are nearly level and poorly drained. They formed under prairie grasses. The surface layer is black silt loam and silty clay loam about 14 inches thick. The subsoil is silty clay about 36 inches thick.

The minor soils in this association are moderately sloping Clarinda and Clearfield soils. Clarinda soils are poorly drained and formed in gumbotil. They are on the lower parts of side slopes at the heads of drainageways. Clearfield soils are poorly drained and formed in loess. They are on the upper parts of side slopes at the heads of drainageways.

Content of organic matter in the surface layer is high in most of these soils. Available water capacity is high.

The nearly level and gently sloping soils of this association are well suited to row crops. Cash grain farming is the major enterprise.

The main concern of management is improving drainage. Tile drainage is used in the Haig soils, and intercep-

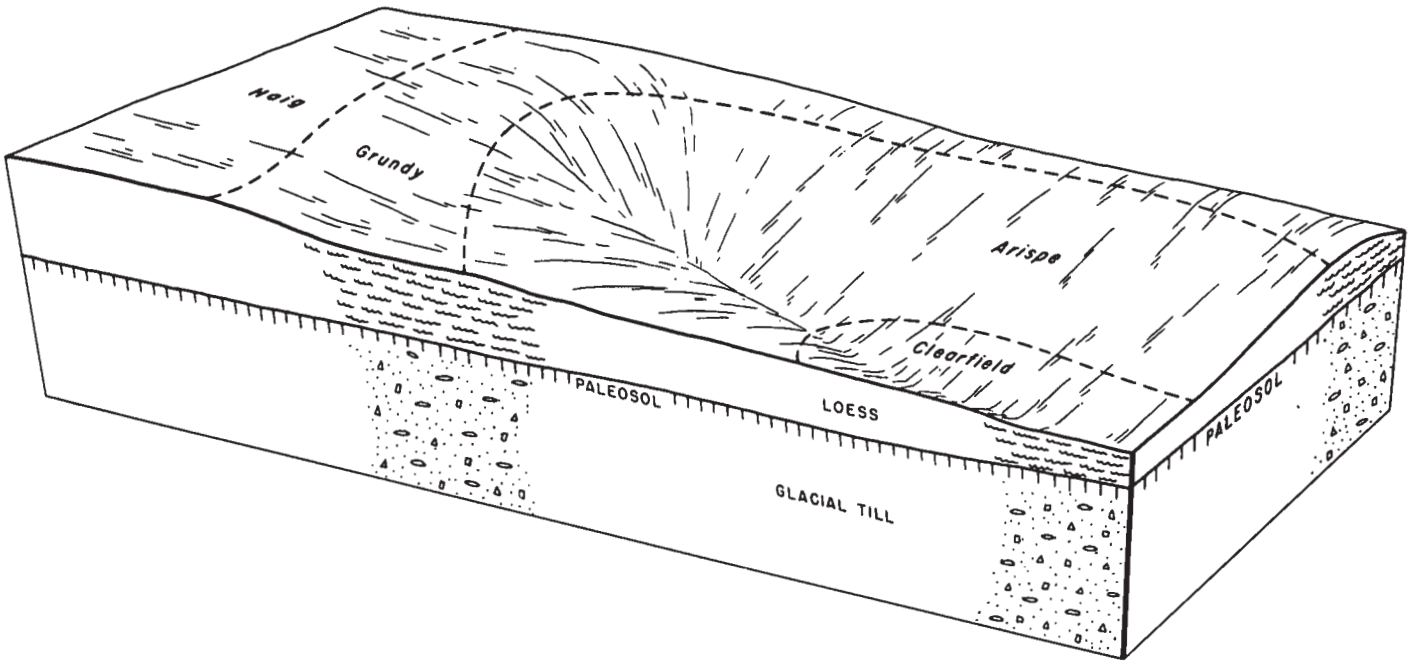


Figure 3.—Typical pattern of soils in the Arispe-Grundy-Haig association.

tor tile is used to keep water from seeping into the Clarinda and Clearfield soils. Contour farming and terraces help to control erosion on the gently sloping Grundy soils and the moderately sloping Arispe soils.

Two State highways and one county highway are on the upland divides in this association.

4. Fayette-Downs association

Gently sloping to steep, well drained soils that formed in loess on uplands

This association is on convex ridgetops and strongly sloping to steep side slopes. This association covers about 5 percent of the county. It is about 40 percent Fayette soils, 40 percent Downs soils, and 20 percent minor soils (fig. 4).

Fayette soils are on convex ridgetops and side slopes. The soils are gently sloping to steep and are well drained. They formed under forest. The surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is silty clay loam about 40 inches thick.

Downs soils are on convex ridgetops and side slopes. The soils are gently sloping to strongly sloping and are well drained. They formed under mixed prairie grasses and trees. The surface layer is very dark gray silt loam about 8 inches thick. The subsurface layer is very dark grayish brown silt loam about 3 inches thick. The subsoil is silty clay loam to a depth of 60 inches or more.

The minor soils in this association are Tama, Gosport, Lindley, Colo, and Ely soils. Some Rock outcrop is also included. Tama soils are gently sloping and moderately sloping on ridgetops and strongly sloping on side slopes; they formed in loess. Gosport soils are strongly sloping to steep; they formed in shale on side slopes. Lindley soils are strongly sloping to steep; they formed in glacial till on side slopes. Colo and Ely soils are gently sloping; they formed in alluvium in drainageways. Rock outcrop is on very steep side slopes and escarpments bordering major streams.

Content of organic matter is moderate to very low, and the soils tend to puddle. All of the major soils have high available water capacity.

The soils of this association are used primarily for row crops, hay, and pasture. Many areas of moderately steep and steep soils are in woodland. Farming is diversified (fig. 5).

The main concern of management is controlling water erosion.

In many places roads follow ridgetops and avoid the bottom lands instead of forming a rectangular pattern.

5. Ladoga-Clinton-Otley association

Gently sloping to strongly sloping, moderately well drained soils that formed in loess on uplands

This soil association consists mostly of gently sloping and moderately sloping soils on convex ridgetops and strongly sloping soils on side slopes that have many drainageways (fig. 6). Included are some upland divides 1/8 to 1/4 mile wide. This association covers about 16 percent of the county. It is about 25 percent Ladoga soils, 20 percent Clinton soils, 15 percent Otley soils, and 40 percent minor soils.

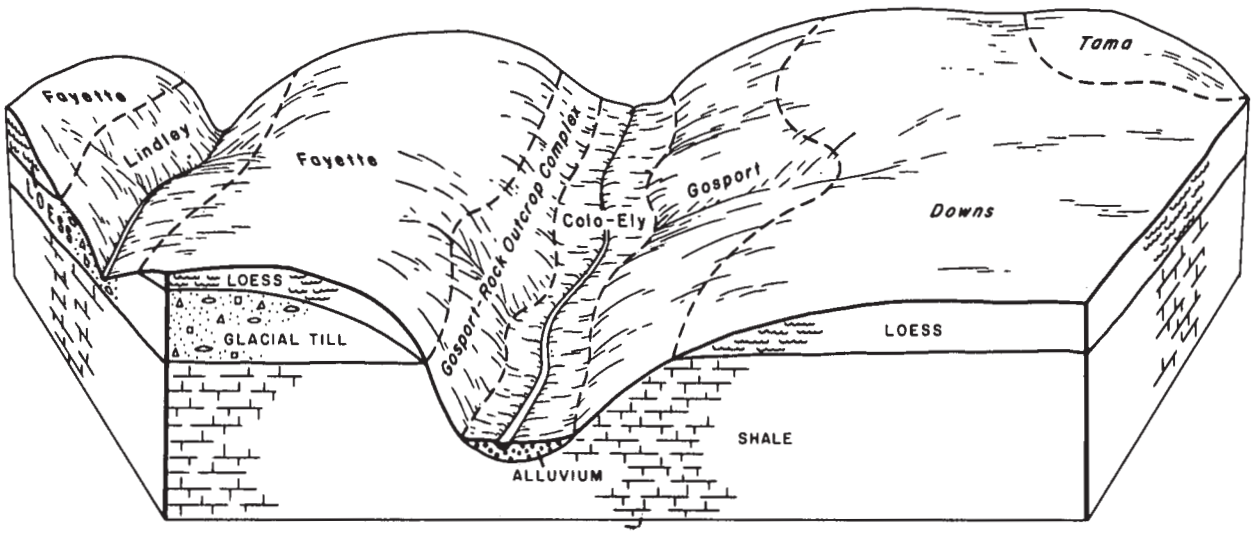


Figure 4.—Typical pattern of soils in the Fayette-Downs association.

Figure 5.—Area of the Fayette-Downs association.

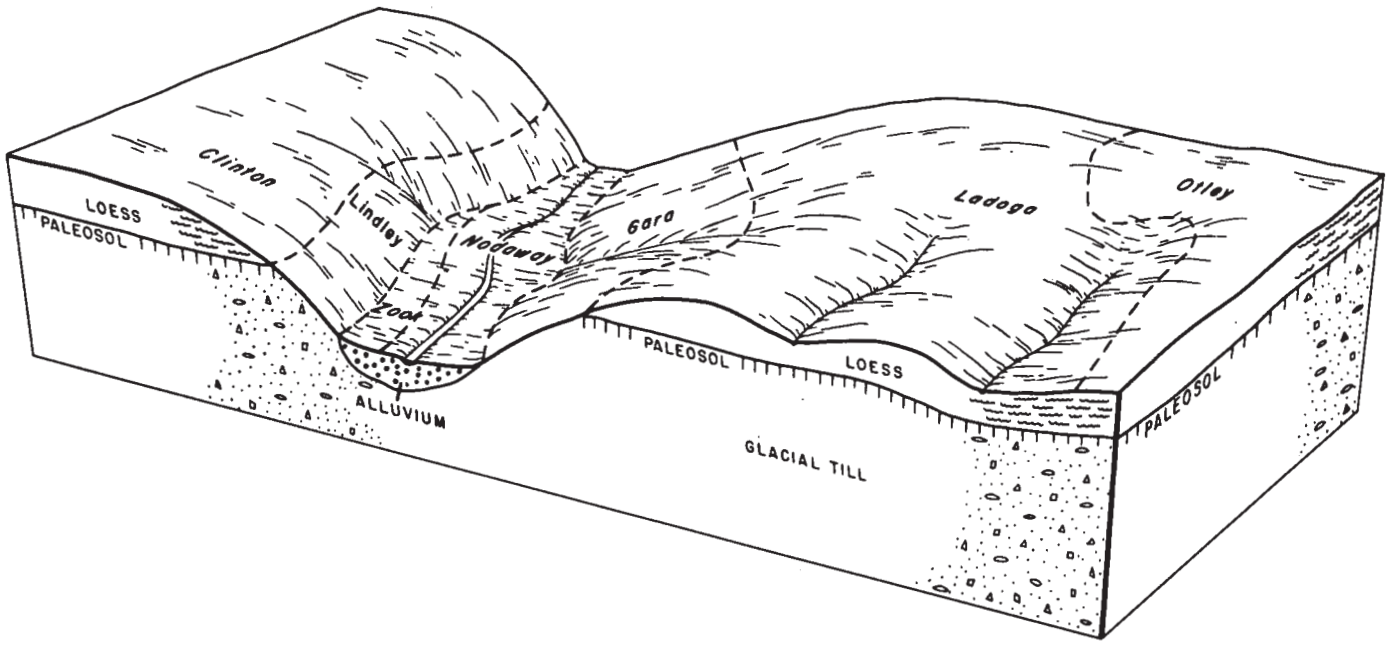


Figure 6.—Typical pattern of soils in the Ladoga-Clinton-Otley association.

Ladoga soils are on convex ridgetops and side slopes. The soils are gently sloping to strongly sloping and are moderately well drained. They formed under mixed prairie grasses and trees. The surface layer is very dark gray silt loam about 9 inches thick. The subsurface layer is dark grayish brown silt loam about 3 inches thick. The subsoil is silty clay loam to a depth of 60 inches or more.

Clinton soils are on convex ridgetops and side slopes. The soils are gently sloping to strongly sloping and are moderately well drained. They formed under forest. The surface layer is dark grayish brown silt loam about 5 inches thick. The subsurface layer is brown silt loam about 3 inches thick. The subsoil is silty clay loam to a depth of 48 inches or more.

Otley soils are on convex ridgetops and side slopes. The soils are gently sloping to strongly sloping and are moderately well drained. They formed under native prairie. The surface layer is very dark brown and very dark grayish brown silty clay loam about 20 inches thick. The subsoil is silty clay loam about 26 inches thick.

The minor soils in this association are Mahaska, Lindley, and Gara soils and several other soils on bottom lands. Mahaska soils are on divides between tributaries of the major rivers. They are somewhat poorly drained and are nearly level and gently sloping. Strongly sloping to steep Lindley and Gara soils formed in glacial till on side slopes. The nearly level Nodaway, Ackmore, Colo, and Zook soils are on the bottom lands of major rivers. The gently sloping Colo and Ely soils formed in colluvial and alluvial material in drainageways.

Content of organic matter in the surface layer is moderate to high. Available water capacity is high.

The soils of this association are used primarily for row crops, hay, and pasture. Many areas of moderately steep and steep soils are in woodland or permanent pasture. Farming is diversified.

The main concern of management is controlling water erosion.

The roads and highways form a rectangular pattern in most places. Many of the roads and highways follow section lines.

6. Ladoga-Sharpsburg-Clinton association

Gently sloping to strongly sloping, moderately well drained soils that formed in loess on uplands

This association consists mostly of gently sloping and moderately sloping soils on convex ridgetops and strongly sloping soils on side slopes (fig. 7). This association covers 29 percent of the county. It is about 29 percent Ladoga soils, 26 percent Sharpsburg soils, 23 percent Clinton soils, and 22 percent minor soils.

Ladoga soils are on convex ridgetops and side slopes. The soils are gently sloping to strongly sloping and are moderately well drained. They formed under mixed prairie grasses and trees. The surface layer is very dark gray silt loam about 9 inches thick. The subsurface layer is dark grayish brown silt loam about 3 inches thick. The subsoil is silty clay loam to a depth of 60 inches or more.

Sharpsburg soils are on convex ridgetops and side slopes. The soils are gently sloping to strongly sloping and are moderately drained. They formed under native prairie. The surface layer is very dark gray, dark grayish brown, and very dark grayish brown silty clay loam about 17 inches thick. The subsoil is silty clay loam about 39 inches thick.

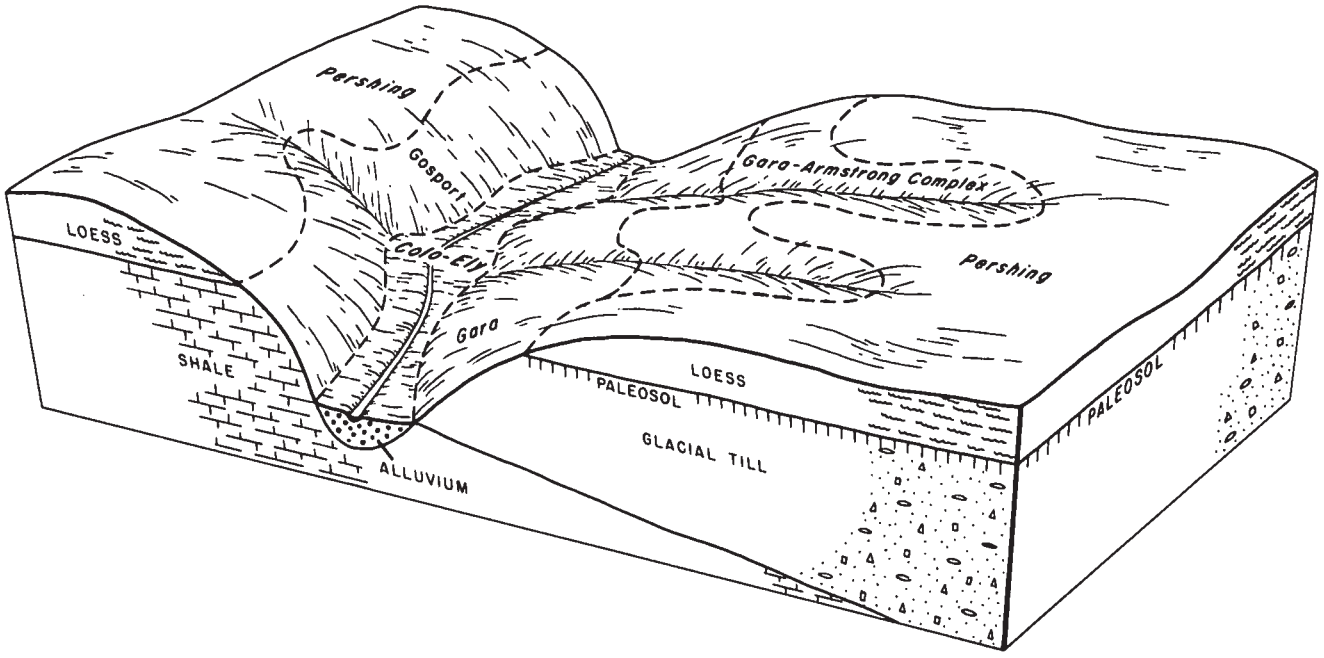


Figure 7.—Typical pattern of soils in the Ladoga-Sharpsburg-Clinton association.

Clinton soils are on convex ridgetops and side slopes. The soils are gently sloping to strongly sloping and are moderately well drained. They formed under forest. The surface layer is dark grayish brown silt loam about 5 inches thick. The subsurface layer is brown silt loam about 3 inches thick. The subsoil is silty clay loam to a depth of 48 inches or more.

The minor soils in this association are Gosport, Lindley, Colo, and Ely soils. The strongly sloping to steep Gosport soils formed in residuum from shale on side slopes. Gosport soils are generally downslope from the major soils of the association. The strongly sloping to steep Lindley soils formed in glacial till on side slopes. The gently sloping Colo and Ely soils formed in colluvial and alluvial material in drainageways.

Content of organic matter in the surface layer is moderate to high. All of the major soils have high available water capacity.

The soils of this association are used primarily for row crops, hay, and pasture. Many areas of moderately steep soils are in woodland or permanent pasture. Farming is diversified.

The main concern of management is controlling water erosion.

The roads and highways form a rectangular pattern in most places. Many roads and highways follow section lines.

7. Gosport-Pershing-Gara association

Gently sloping to steep, well drained to somewhat poorly drained soils that formed in residuum from shale, glacial till, and loess on uplands

This soil association consists mostly of strongly sloping to steep soils that formed in shale and glacial till on upland side slopes and gently sloping to strongly sloping soils that formed in loess (fig. 8). This association covers about 27 percent of the county. It is about 45 percent Gosport soils, 15 percent Pershing soils, 10 percent Gara soils, and 30 percent minor soils.

Gosport soils are on side slopes. The soils are strongly sloping to steep and are moderately well drained. They formed in residuum from shale under forest. The surface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is silty clay 20 inches thick. The substratum is clay shale.

Pershing soils are on convex ridgetops and side slopes and on high stream benches. The soils are gently sloping and moderately sloping and are moderately well drained to somewhat poorly drained. Pershing soils formed in loess under mixed prairie grasses and trees. The surface layer is very dark gray and very dark grayish brown silt loam about 7 inches thick. The subsurface layer is dark grayish brown silt loam about 2 inches thick. The subsoil is silty clay loam and a layer of silty clay; the subsoil extends to a depth of 50 inches or more.

Gara soils are on convex side slopes. The soils are strongly sloping to steep and are well drained and moderately well drained. Gara soils formed in glacial till under mixed prairie grasses and trees. The surface layer is very dark brown loam about 7 inches thick. The subsurface layer is dark grayish brown loam about 4 inches thick.

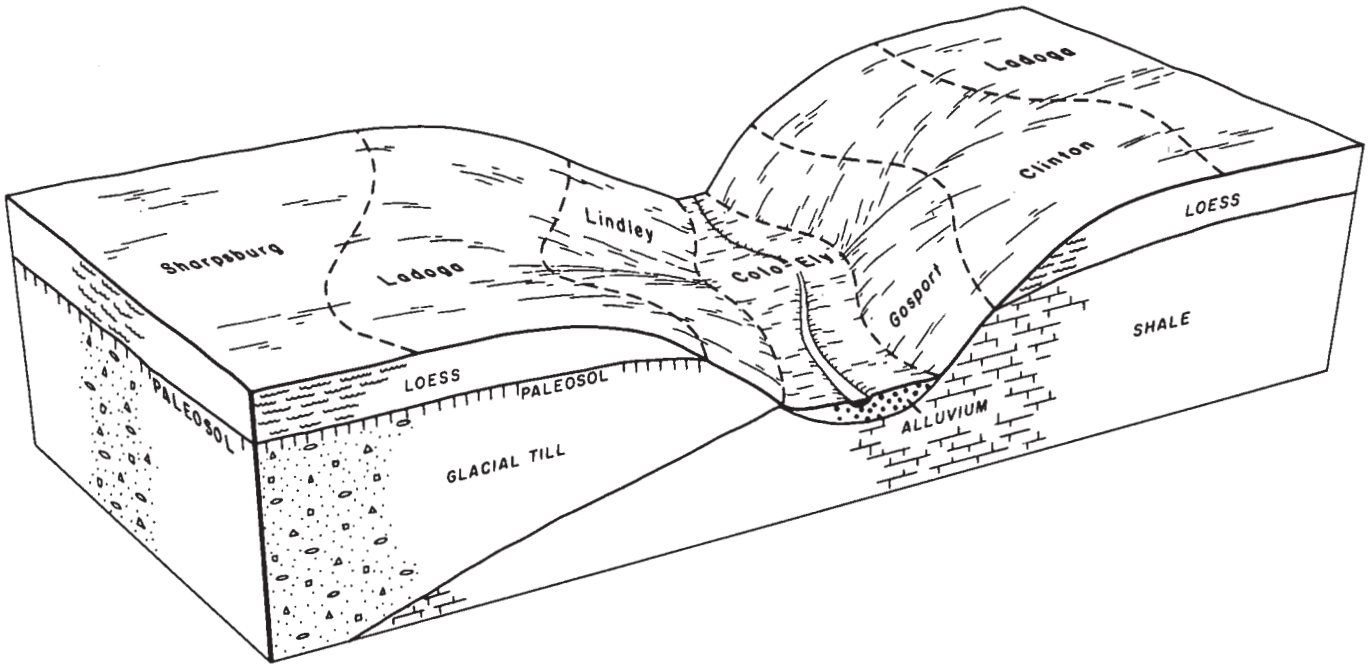


Figure 8.—Typical pattern of soils in the Gosport-Pershing-Gara association.

The subsoil is clay loam and loam to a depth of 41 inches or more.

The minor soils in this association are Weller, Lindley, Armstrong, Colo, and Ely soils. Weller soils are similar to Pershing soils but have a thinner surface layer. Lindley soils are similar to Gara soils but have a thinner surface layer. Armstrong soils have a reddish clayey subsoil. Colo and Ely soils are poorly drained and somewhat poorly drained and are in small upland waterways and on bottom lands.

Content of organic matter in the surface layer ranges from high to low. All of the soils except Gosport soils have high available water capacity.

The strongly sloping to steep soils of this association are used mostly for hay, pasture, and woodland (fig. 9). The gently sloping and moderately sloping soils are used for row crops. Many farms have beef herds.

The main concern of management is controlling erosion.

There is considerable mileage of dirt road in the association. Roads follow the narrow ridgetops in many places.

8. Nodaway-Zook-Ackmore association

Nearly level and gently sloping, poorly drained to moderately well drained soils that formed in alluvium on flood plains of major streams

This association is mainly on flood plains and low stream benches. This association is on areas 1 to 2 miles wide along the major river valleys and areas 1/3 to 2/3 mile wide along the tributaries of the major rivers. The wider bottom lands have old stream channels in many places and have meander scars near the present channel. Coarser textured alluvium is next to the stream channel in most places. Soils that formed on low stream benches are generally on bottom lands more than 1/2 mile wide. Most areas of this association are subject to flooding. This association covers about 8 percent of the county. It is about 40 percent Nodaway soils, 22 percent Zook soils, 10 percent Ackmore soils, and 28 percent minor soils.

Nodaway soils are near original and present stream channels. The soils are nearly level and gently sloping and are moderately well drained. The surface layer is very dark grayish brown silt loam about 8 inches thick. The substratum is stratified silt loam and thin bands of very fine sandy loam; it extends to a depth of 60 inches or more.

Zook soils are on flood plains. The soils are nearly level and poorly drained. The upper part of the surface layer is black silty clay loam about 22 inches thick, and the lower part is very dark silty clay loam about 17 inches thick. The subsoil is clay loam about 14 inches thick. The substratum is gray and light gray silty clay loam to a depth of 63 inches or more.

Ackmore soils are on flood plains. The soils are nearly level and somewhat poorly drained. The surface layer is very dark grayish brown silt loam about 8 inches thick. The substratum is stratified silt loam to a depth of about 32 inches. Below this is a buried soil that is black silty clay loam to a depth of 60 inches or more.

The minor soils in this association are Bremer, Nevin, Huntsville, Spillville, Colo, Ladoga, Sharpsburg, Givin,

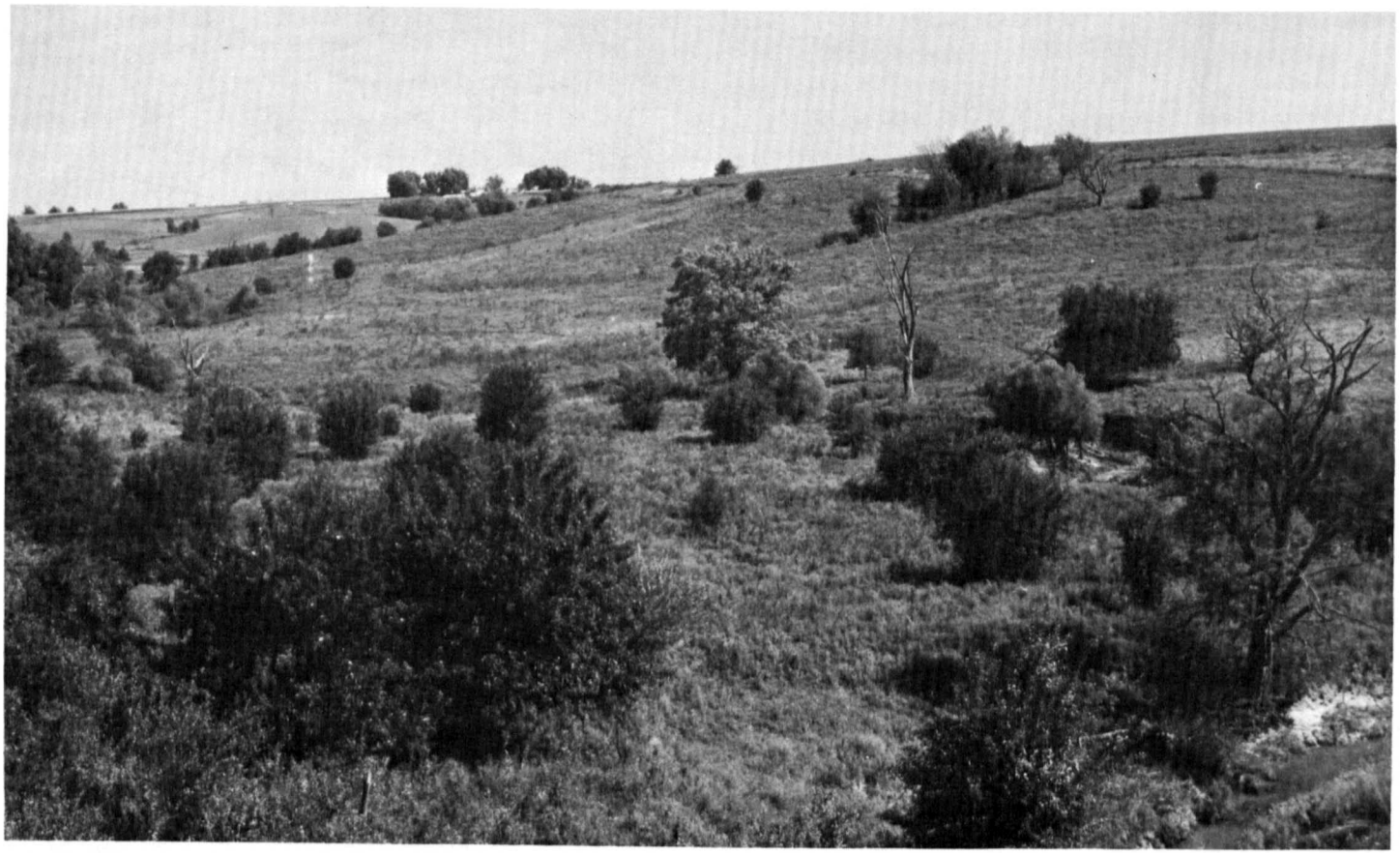


Figure 9.—Area of the Gosport-Pershing-Gara association.

Macksburg, Pershing, and Landes soils and Alluvial land. The poorly drained Bremer soils, somewhat poorly drained Nevin soils, and moderately well drained to somewhat poorly drained Spillville soils are on low stream benches. The well drained and moderately well drained Huntsville soils are on high flood plains and low stream benches. The poorly drained Colo soils are on flood plains. The moderately well drained Ladoga and Sharpsburg soils and the somewhat poorly drained Givin, Macksburg, and Pershing soils are on loess-covered benches. The nearly level, well drained, fine sandy loam Landes soils are on flood plains. Alluvial land is coarsely stratified silt and sand. Alluvial land is along original and present channels on wide bottom lands.

Content of organic matter in the surface layer is moderate to high. Available water capacity is high to very high.

Cash grain farming is the major enterprise, although few farms are entirely on bottom land and benches. Most of the soils in this association are used intensively for row crops (fig. 10). The low water holding capacity in many places limits crops. Most channeled areas have been left in trees.

Areas at the upstream end of Red Rock Lake are subject to frequent flooding by the lake. The vegetation is presently small willows and grasses that tolerate excessive wetness. Probably the only use for this land is wildlife habitat.

In most of this association the main concerns of management are controlling flooding and improving drainage. Tile drains normally function satisfactorily in most of the soils. Diversions and drainage ditches are useful in keeping overflow from adjacent uplands off these soils.

Because of seasonal flooding of the Des Moines River valley, there are no roads or farmsteads in this association above Red Rock Lake. In the rest of this association there are few roads and farmsteads, probably because of the hazard of flooding.

Soil maps for detailed planning

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. And they 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."

Figure 10.—Area of the Nodaway-Zook-Ackmore association.

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. A brief description of the soil profile, and a listing of the principal hazards and limitations to be considered in planning management.

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 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, Pershing silt loam, 2 to 5 percent slopes, is one of several phases in the Pershing 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 in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Shelby-Adair complex, 9 to 14 percent slopes, moderately eroded 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 from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Riverwash is an example. Miscellaneous

areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil descriptions

8B—Judson silty clay loam, 2 to 5 percent slopes. This gently sloping, well drained or moderately well drained soil is on slightly concave foot slopes or on nearly level fans where waterways empty into the bottom lands. Areas are commonly long, narrow, and regular in shape. They are typically 5 to 15 acres in size.

Typically, the surface layer is very dark brown and very dark grayish brown silty clay loam about 25 inches thick. The subsoil extends to a depth of 60 inches or more. It is very dark grayish brown silty clay loam in the upper part and dark brown and brown silty clay loam in the lower part. In some areas the dark colored surface layer is only 12 to 24 inches thick. In a few areas the subsoil is olive or grayish brown. A few areas have 7 to 12 inches of recently deposited silty material on the surface; these deposits are usually lighter in color and lower in organic matter than the typical surface layer.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus and potassium are low. Unless limed, the surface layer is generally medium acid or slightly acid. Surface runoff is slow or medium. Organic matter content in the surface layer is high.

This soil is well suited to intensively grown row crops.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent soil loss. Diversion terraces are needed in places to protect this soil from runoff from higher lying soils. Returning crop residue to the soil and regularly adding other organic material improve fertility and help maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring at appropriate times, grazing and restricting use during wet periods help keep 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 soil is on slightly convex foot slopes. Individual areas are usually long, narrow, and regular in shape and typically are 4 to 8 acres in size.

Typically, the surface layer is very dark brown and very dark grayish brown silty clay loam about 25 inches thick. The subsoil extends to a depth of 60 inches or more. It is very dark grayish brown silty clay loam in the upper part and dark brown and brown silty clay loam in the lower part. In some areas the surface layer is silty clay loam that has enough sand to feel gritty; this material is recently eroded from loamy glacial soils upslope. In a few places this Judson soil has a lighter colored surface layer.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus and potassium are low. Unless limed, the surface layer is generally medium acid or slightly acid. Surface runoff is medium. Organic matter content of the surface layer is high.

This soil is suited to row crops.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps to prevent soil loss. Diversion terraces are needed in places to protect this soil from runoff from higher lying soils. Returning crop residue to the soil or regularly adding other organic material improve fertility and helps maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIIe.

11B—Colo-Ely silty clay loams, 2 to 5 percent slopes. These gently sloping, poorly drained and somewhat poorly drained soils are in small upland drainageways and larger drainageways leading to bottom lands. The soils in this complex are generally wet because of runoff from more sloping soils upslope. Individual areas are as much as a mile or more long. They are elongated and are 3 to 50 acres in size. The Colo soils are typically adjacent to the waterways and are subject to flooding. Ely soils are at the base of side slopes in fairly uniform bands along the edges of the mapped areas. In many places these areas are cut by channels or gullies that cannot be crossed by farm machinery. This complex is about 40 percent Colo soil, 40 percent Ely soil, and 20 percent Zook, Judson, Olmitz, and Ackmore soils. These soils are in such an intricate pattern that it is impractical to map each kind separately.

Typically, the surface layer of the Colo soil is very dark brown and black silty clay loam about 46 inches thick. The substratum is very dark gray silty clay loam.

The Colo soil has moderate permeability and high available water capacity. The available subsoil phosphorus is medium, and the available subsoil potassium is

very low. The surface layer is medium acid to neutral. Surface runoff is slow to medium. Organic matter content in the surface layer is high.

Typically, the Ely soil has a surface layer of very dark grayish brown silty clay loam about 25 inches thick. The subsoil extends to a depth of 60 inches or more. It is dark grayish brown silty clay loam in the upper part, grayish brown silty clay loam in the middle part, and light olive gray silty clay loam in the lower part.

The Ely soil has moderate permeability and high available water capacity. The available subsoil phosphorus is low, and available subsoil potassium is very low. The surface layer is slightly acid to neutral. Surface runoff is slow or medium. Organic matter content in the surface layer is high.

These soils are well suited to row crops. Some areas are used for grassed waterways. Most areas of this complex are cropped with surrounding soils because they are too small, narrow, and irregular to be cropped separately.

Drainageways that carry a high concentration of water need to be maintained in grass to prevent gullying. Subsurface drainage is needed on each side of some waterways to remove excess water. Minimum tillage helps prevent soil loss. In some places contouring and terracing are beneficial. Returning crop residue to the soil or regularly adding other organic material improves ferility and helps maintain good tilth.

The use of these soils for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increased runoff, and poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at the appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This complex is in capability subclass IIw.

13B—Nodaway-Vesser silt loams, 2 to 5 percent slopes. These gently sloping soils are along the wider drainageways and along tributaries of creeks and rivers. These soils are subject to flooding. Individual areas are long and irregular in shape. In many places the areas are a mile or more long and are 15 to 80 acres in size. The moderately well drained Nodaway silt loam is in the middle of the areas adjacent to the stream channel. The poorly drained to somewhat poorly drained Vesser silt loam is along the sides of the areas on slightly higher foot slopes. This complex is about 50 percent Nodaway soil, 30 percent Vesser soil, and 20 percent Colo, Zook, and Ackmore soils. These soils are in such an intricate pattern that it is impractical to map them separately.

Typically, the Nodaway soil has a surface layer of very dark grayish brown silt loam about 8 inches thick. The substratum has layers of brown, very dark grayish brown, and pale brown silt loam with strata of fine sandy loam in the lower part.

The Nodaway soil has moderate permeability and very high available water capacity. The water table is commonly high in spring and early summer. The available subsoil phosphorus and potassium are medium. These soils are slightly acid to neutral in the most acid part. Surface runoff is slow or medium. Organic matter content is variable.

Typically, the Vesser soil has a surface layer of very dark gray and very dark grayish brown silt loam about 15 inches thick. The subsurface layer is dark gray, dark grayish brown, and grayish brown silt loam about 19 inches thick. The subsoil extends to a depth of about 70 inches. It is dark grayish brown silty clay loam in the upper part and dark gray silty clay loam in the lower part.

The Vesser soil has moderate permeability and high available water capacity. The water table is commonly high in spring and early summer. The available subsoil phosphorus is medium, and the available subsoil potassium is low. Unless limed, the surface layer is slightly acid. Surface runoff is slow or medium. Organic matter content in the surface layer is moderate.

The soils in this complex are well suited to row crops. Areas of this complex are rather inaccessible in many places, because the adjacent valley sides are usually steep, and drainageways meander. In many places this soil remains in pasture or woodland.

Drainageways that carry a high concentration of water need to be maintained and grassed to help prevent gullying. Subsurface drainage is needed on each side of some drainageways to remove excess water. Minimum tilllage helps prevent soil loss. In some places contouring and terracing are beneficial. Returning crop residue to the soil or regularly adding other organic material improves ferility and helps maintain good tilth.

The use of these soils for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at the appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This complex is in capability subclass IIe.

24D2—Shelby loam, 9 to 14 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on convex side slopes and on some low, narrow ridgetops. Individual areas are long and narrow, and are generally parallel to intermittent streams. Areas are 5 to 15 acres in size.

Typically, the surface layer is very dark grayish brown and brown loam about 8 inches thick. The subsoil extends to a depth of about 42 inches. It is brown and dark brown clay loam in the upper part and yellowish brown clay loam in the lower part. The substratum is yellowish brown loam.

This soil has moderately slow permeability and high available water capacity. The available subsoil phosphorus is low, and the available subsoil potassium is high.

Unless limed, the surface layer is medium acid or slightly acid. Surface runoff is medium or rapid. Organic matter content in the surface layer is moderate.

This soil is suited to row crops but is susceptible to erosion. This soil is often used for hay and pasture.

Minimum tillage helps prevent soil loss if this soil is cultivated. In most places contouring and terracing are beneficial. In wet years field work is delayed slightly. Because providing adequate erosion control and drainage is difficult, a combination of terracing and subsurface drainage is necessary in some places. Returning crop residue to the soil or regularly adding other organic material improves fertility and soil tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when this soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIIe.

24E2—Shelby loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, moderately well drained soil is on irregular, convex side slopes that are dissected by gullies and waterways. Individual areas are long and are generally parallel to intermittent streams. Areas are usually about 5 to 10 acres in size.

Typically, the surface layer is very dark grayish brown and brown loam about 8 inches thick. The subsoil is brown and dark brown clay loam in the upper part and yellowish brown clay loam in the lower part. The substratum is yellowish brown clay loam. The substratum is at a depth of less than 40 inches. In many places the surface layer has been mixed with the subsoil and the plow layer is clay loam.

This soil has moderately slow permeability and high available water capacity. Available subsoil phosphorus is low, and available subsoil potassium is high. Unless limed, the surface layer is medium acid or slightly acid. Surface runoff is rapid. Organic matter content in the surface layer is moderate.

Because this soil is too steep for use of ordinary farm machinery, it is not suited to corn, soybeans, and small grains. It is suited to grasses and legumes for hay and pasture.

If this soil is cultivated, there is a severe hazard of erosion. This soil is too steep for the construction of terraces and has an unfavorable firm subsoil, is moderately slowly permeable, and is difficult to revegetate if the subsoil is exposed.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain soil tilth.

This soil is in capability subclass IVe.

43—Bremer silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on low second bottoms along major streams. This soil is subject to occasional flooding. Individual areas are rather small and somewhat elongated, generally in the direction of the river bottom or paralleling the valley. Areas range from 20 to 40 acres in size.

Typically, the surface layer is black silty clay loam about 14 inches thick. The subsoil extends to a depth of about 50 inches. It is very gray dark silty clay loam in the upper part, dark gray silty clay loam with common yellowish brown mottles in the middle part, and dark gray to mottled light olive gray silty clay loam in the lower part. The substratum is mottled light olive gray and yellowish brown silty clay loam. In some areas the dark colored upper layer is only 20 to 24 inches thick.

This soil has moderately slow permeability and high available water capacity. This soil has a seasonal high water table. The subsoil is low in available phosphorus and available potassium. These soils are generally slightly acid or neutral throughout, but some are medium acid in the surface layer unless limed. Surface runoff is slow. Organic matter content in the surface layer is high.

This soil is well suited to corn, soybeans, and small grains. It is also well suited to grasses and legumes for hay and pasture.

Diversion terraces above this soil protect it from runoff and siltation. Subsurface drainage can improve the timeliness of field operations. This soil is susceptible to puddling when wet, and it is cloddy and hard when dry. Returning crop residue to the soil or regularly adding of other organic material improves fertility and helps maintain good tilth.

If this soil is used for pasture, overgrazing the pasture or grazing when the soil is too wet causes surface compaction and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and the soil in good condition.

This soil is in capability subclass IIw.

51—Vesser silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained to poorly drained soil is on bottom land along major streams. This soil is subject to flooding. Individual areas are irregular in shape or elongated and are 5 to 15 acres in size.

Typically, the surface layer is very dark gray and very dark grayish brown silt loam about 15 inches thick. The subsurface layer is dark gray, dark grayish brown, and grayish brown silt loam about 19 inches thick. The sub-

soil extends to a depth of about 70 inches. It is dark grayish brown silty clay loam in the upper part and dark gray silty clay loam in the lower part. In some areas the surface layer is less than 10 inches thick, the subsurface layer is thinner, and the subsoil is less gray. A few areas have as much as 18 inches of very dark grayish silt loam overwash.

This soil has moderate permeability and high available water capacity. It also has a seasonal high water table. The available subsoil phosphorus is medium, and the available subsoil potassium is low. Unless limed, the surface layer is slightly acid. Surface runoff is slow. Organic matter content in the surface layer is moderate.

This soil is suited to corn, soybeans, and small grains. It is also suited to grasses and legumes for hay and pasture. This soil is subject to flooding during periods of heavy rain; this flooding damages crops in some years.

Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

If this soil is used for pasture or hay, overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIw.

53—Riverwash. Nearly level Riverwash is mostly along the Des Moines River. The areas are islands of sand and some gravel within the river channel and similar deposits along the banks of the river. The streambank deposits of Riverwash are associated with Alluvial land but are generally lower on the landscape. When the river level is high, most areas of Riverwash are under water. These areas change shape and size with changes in the river channel. Areas of Riverwash are elongated in the direction of the stream channel and are 2 to 20 acres in size.

Areas of Riverwash generally have no vegetation except a few thickets of small willows. Riverwash has no agricultural value. Its position within or adjacent to the river channel limits its suitability as a source of sand and gravel for roads and other construction.

Riverwash is in capability subclass VIIs.

54—Zook silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on low, flat flood plains adjacent to foot slopes and bench escarpments. This soil is generally some distance from the main stream channel. This soil is subject to flooding. Individual areas are longer than they are wide and are somewhat parallel to the stream channel. Areas are 10 to 40 acres in size.

Typically, the surface layer is black silty clay loam about 22 inches thick. The subsurface layer is very dark gray silty clay loam about 17 inches thick. The subsoil extends to a depth of about 53 inches. It is dark gray silty clay loam. The substratum is gray and light gray silty clay loam. Some areas have several inches of very dark grayish brown silt loam or silty clay loam overwash. In some areas the dark colored surface layer is 30 inches or less thick.

This soil has slow permeability and high available water capacity. The available subsoil phosphorus is low, and available subsoil potassium is very low. Unless limed, the surface layer is generally slightly acid. Surface runoff is very slow. Organic matter content of the surface layer is high.

If drained, this soil is suited to corn and soybeans and to grasses and legumes for hay and pasture.

Spring plowing and planting are sometimes delayed by flooding. Artificial drainage may be needed to lower the water table and improve the timeliness of field operation. Diversion terraces reduce flooding. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth. This soil usually does not need lime.

If this soil is used for pasture or hay, overgrazing the pasture or grazing when the soil is too wet causes surface compaction and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIw.

54+—Zook silt loam, overwash, 0 to 2 percent slopes. This nearly level, poorly drained soil is on low, flat flood plains. The overwash is deposited by flood waters from tributary streams and from the main stream on the flood plain. Individual areas usually are longer than they are wide and are somewhat parallel to the stream channel. Areas are 10 to 20 acres in size.

Typically, the surface layer is very dark grayish brown and dark gray silt loam and silty clay loam about 10 to 18 inches thick. The next layer is black silty clay loam about 39 inches thick. The subsoil extends to a depth of about 60 inches. It is dark gray silty clay loam. The substratum is gray silty clay loam. In some small areas the overwash is 18 to 36 inches thick.

This soil has slow permeability and high available water capacity. The available subsoil phosphorus is low, and the available subsoil potassium is very low. Unless limed, the surface layer is generally slightly acid. Surface runoff is very slow. Organic matter content in the surface layer is moderate.

This soil is suited to corn and soybeans and to grasses and legumes for pasture and hay if the soil is drained and if flooding is not too frequent.

Spring plowing and planting may be delayed by flooding. This soil is generally not as wet as Zook silty clay, which has no overwash, but crops benefit from artificial drainage. Because the surface layer is silt loam, plowing and preparation of seed bed is easier in this soil than on

other Zook soils. Diversion terraces above this soil protect it from siltation. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

If this soil is used for pasture or hay, overgrazing the pasture or grazing when the soil is too wet causes surface compaction and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIw.

63C—Chelsea loamy fine sand, 5 to 9 percent slopes. This moderately sloping, excessively drained soil is on ridgetops and side slopes along the larger streams and rivers. Individual areas are irregular in shape and 5 to 20 acres in size.

Typically, the surface layer is very dark grayish brown and dark brown loamy fine sand about 6 inches thick. The subsurface layer is brown, dark yellowish brown, and yellowish brown fine sand. Below a depth of about 31 inches the soil is pale brown and brownish yellow fine sand with thin brown bands of material higher in clay and iron. Some small areas are severely eroded, and a few areas are gently sloping. In a few areas the soil is very dark brown loamy fine sand.

This soil has rapid permeability and low available water capacity. The available subsoil phosphorus and potassium are very low. Unless limed, the surface layer is slightly acid. Surface runoff is slow to medium because of rapid infiltration of rainfall. Organic matter content in the surface layer is moderately low.

Because this soil is droughty and low in fertility, it is poorly suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Crop production depends on the amount and timeliness of rain. This soil is suited to trees. A few small areas remain in native hardwoods. Some Christmas trees are produced on this soil (fig. 11).

If this soil is cultivated, there is a hazard of erosion. Soil blowing damages seedlings on this soil and on adja-

Figure 11.—Christmas trees on Chelsea loamy fine sand, 5 to 9 percent slopes.

cent soils. Minimum tillage and winter cover crops help prevent excessive soil loss. In most places contouring is beneficial. This soil is not suitable for terracing because of the poor stability and difficulty of constructing and maintaining the terraces. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during dry periods help keep pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed by site preparation, prescribed burning, or spraying, cutting, and girdling.

This soil is in capability subclass IVs.

63E2—Chelsea loamy fine sand, 9 to 18 percent slopes, moderately eroded. This strongly sloping and moderately steep, excessively drained soil is on convex, dissected side slopes along the larger streams and rivers. Individual areas are irregular in shape and 5 to 15 acres in size.

Typically, the surface layer is very dark grayish brown to dark brown loamy fine sand about 4 inches thick. The subsurface layer is brown, dark yellowish brown, and yellowish brown fine sand. Below a depth of about 31 inches the soil is pale brown or brownish yellow fine sand with thin brown bands of material higher in clay and iron.

This soil has rapid permeability and low available water capacity. The available subsoil phosphorus and potassium are very low. Unless limed, the surface layer is slightly acid. Surface runoff is slow or medium because of rapid infiltration of rainfall. Organic matter content of the surface layer is low.

This soil is not suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture; this soil is droughty, low in fertility, and strongly sloping to steep. This soil is suited to trees. A few small areas remain in native hardwoods.

If this soil is cultivated, there is a hazard of erosion. This soil is subject to wind erosion and should be protected by a plant cover at all times. This soil is not suitable for terracing because of poor stability and difficulty of constructing and maintaining terraces.

The use of this soil for pasture or hay is effective in controlling erosion. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during dry periods help keep pasture and soil in good condition. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed by site preparation, prescribed burning, or spraying, cutting, and girdling.

This soil is in capability subclass VIs.

65D2—Lindley loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on convex upland side slopes and on some narrow ridgetops in strongly dissected areas. Individual areas are smaller and contain fewer hillside waterways than areas of steeper Lindley soils. Areas of this soil are narrow and irregular in shape. They are generally 5 to 15 acres in size.

Typically, the surface layer is dark grayish brown loam about 6 inches thick. It is a mixture of the surface and subsurface layers. The subsoil extends to a depth of about 56 inches. It is brown loam in the upper part, yellowish brown clay loam in the middle part, and yellowish brown and strong brown clay loam in the lower part. The substratum is yellowish brown clay loam. In some small wooded areas the soil has a thin layer of leaf litter, a slightly darker colored surface layer, and a distinctly gray subsurface layer 2 to 7 inches thick.

This soil has moderately slow permeability and high available water capacity. The available subsoil phosphorus is medium, and the available subsoil potassium is very low. Unless limed, the surface layer is strongly acid. Surface runoff is medium or rapid. Organic matter content of the surface layer is moderately low.

This soil is suited to occasional crops of corn, soybeans, and small grains. It is better suited to grasses and legumes for hay and pasture. This soil is well suited to trees. A few areas are reverting to timber.

If this soil is cultivated, there is a hazard of further erosion. Minimum tillage and grassed waterways help prevent excessive soil loss. In some places contouring is beneficial. Terracing is only moderately satisfactory because of the slope, firm subsoil, and moderately slow permeability. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to maintain soil tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed.

This soil is in capability subclass IVe.

65E—Lindley loam, 14 to 18 percent slopes. This moderately steep, well drained soil is on convex sides of

valleys on uplands in the strongly dissected parts of the county. Individual areas are irregular bands. Areas are generally 5 to 30 acres in size.

Typically, the surface layer is very dark grayish brown loam about 7 inches thick. The subsurface layer is dark grayish brown loam about 3 inches thick. The subsoil extends to a depth of about 56 inches. It is brown loam in the upper part, yellowish brown clay loam in the middle part, and yellowish brown and strong brown clay loam in the lower part. The substratum is yellowish brown clay loam. Where this soil has been cultivated the surface layer is lighter colored and in some places is a clay loam mixture of the surface layer and the original subsurface layer and some of the subsoil.

This soil has moderately slow permeability and high available water capacity. The available subsoil phosphorus is medium, and the available subsoil potassium is very low. Unless limed, the surface layer is strongly acid. Surface runoff is rapid. Organic matter content of the surface layer is moderately low.

Because this soil is too steep for use of ordinary farm machinery, it is not suited to corn, soybeans, and small grains. It is suited to grasses and legumes for hay and pasture. This soil is suited to trees. A few small areas remain in native hardwoods.

If this soil is cultivated, there is a severe hazard of erosion. This soil is too steep for construction of terraces, and it also has an unfavorable firm subsoil, is moderately slowly permeable, and is difficult to revegetate when the subsoil is exposed.

The use of this soil for pasture and hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain soil tilth.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed.

This soil is in capability subclass VIe.

65E3—Lindley clay loam, 14 to 18 percent slopes, severely eroded. This moderately steep, well drained soil is on convex sides of valleys on uplands in the strongly dissected parts of the county. Individual areas are irregular bands. Areas are generally 5 to 15 acres in size.

Typically, the surface layer is dark grayish brown clay loam in most places. The subsoil extends to a depth of about 56 inches. It is dark brown loam in the upper part, yellowish brown clay loam in the middle part, and yellowish brown and strong brown clay loam in the lower part. The substratum is yellowish brown clay loam.

This soil has moderately slow permeability and high available water capacity. The available subsoil phosphorus is medium, and the available subsoil potassium is very low. Unless limed, the surface layer is strongly acid. Surface runoff is rapid. Organic matter content of the surface layer is very low.

Because this soil is too steep for use of ordinary farm machinery, it is not suited to corn, soybeans, and small grains. It is suited to grasses and legumes for hay and pasture. This soil is also suited to trees.

If this soil is cultivated, there is a severe hazard of erosion. This soil is too steep for the construction of terraces, and it also has an unfavorable firm subsoil, is moderately slowly permeable, and is difficult to renovate when the subsoil is exposed.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition. Returning crop residue to the soil or adding other organic material improves fertility and soil tilth.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed.

This soil is in capability subclass VIIe.

65F—Lindley loam, 18 to 25 percent slopes. This steep, well drained soil is on the lower part of long slopes in strongly dissected areas. Individual areas are long and narrow and are 10 to 40 acres in size.

Typically, the surface layer is very dark grayish brown loam about 7 inches thick. The subsurface layer is dark grayish brown loam about 3 inches thick. The subsoil extends to a depth of about 56 inches. It is brown loam in the upper part, yellowish brown clay loam in the middle part, and yellowish brown and strong brown clay loam in the lower part. The substratum is yellowish brown clay loam.

This soil has moderately slow permeability and high available water capacity. The available subsoil phosphorus is medium, and the available subsoil potassium is very low. Unless limed, the surface layer is strongly acid. Surface runoff is rapid. Organic matter content of the surface layer is very low.

Because this soil is too steep for use of ordinary farm machinery, it is not suited to corn, soybeans, and small grain. It is better suited to grasses and legumes for hay and pasture. This soil is suited to trees. Many areas remain in native hardwoods.

If this soil is cultivated, there is a severe hazard of erosion. This soil is too steep for the construction of terraces, and it also has an unfavorable firm subsoil, is moderately slowly permeable, and is difficult to revegetate when the subsoil is exposed.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition. Returning crop residue to the soil or regularly adding other organic material improves fertility and soil tilth.

Tree seeds germinate well and seedlings and cuttings survive and grow well if competing vegetation is controlled or removed by site preparation, prescribed burning, or spraying and cutting.

This soil is in capability subclass VIIe.

69C2—Clearfield silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, poorly drained to somewhat poorly drained soil is commonly in coves near upland divides, but it is on concave side slopes in some places. Individual areas are 5 to 10 acres in size.

Typically, the surface layer is very dark gray silty clay loam about 9 inches thick. The subsoil extends to a depth of about 46 inches. It is grayish brown silty clay loam in the upper part, olive gray and light gray silty clay loam in the middle part, and light gray silty clay loam in the lower part. The next layer is light gray clay with strong brown and yellowish brown mottles.

This soil has moderately slow permeability in the upper part and very slow permeability in the lower part. Available water capacity is high. The available subsoil phosphorus and potassium are low. Unless limed, the surface layer is medium acid. Surface runoff is medium. Organic matter content in the surface layer is high.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of further erosion. Minimum tillage helps prevent soil loss. In most places contouring and terracing are beneficial. In wet years field work is delayed because providing adequate erosion control and drainage is difficult. A combination of terracing and subsurface drainage is necessary. For the best drainage, proper placement of the subsurface drainage lines is very important. If possible, the lines should be placed just above or in contact with the underlying clay layer that typically occurs at a depth of 3 to 6 feet. Lines placed in the clay are not as efficient as lines placed on or just above it. Returning crop residue to the soil or regularly adding other organic material improves fertility and soil tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIIw.

75—Givin silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on broad upland divides. Individual areas are rather regular in shape and somewhat longer than wide. They are 5 to 15 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown silt loam about 5 inches thick. The subsoil extends to a depth of 60 inches or more. It is dark grayish brown and brown silty clay loam in the upper part, grayish brown silty clay loam in the middle part, and mottled yellowish brown and light olive gray silty clay loam in the lower part. In some areas the surface layer is thinner and the subsurface layer is a more distinct gray.

This soil has moderately slow permeability and high available water capacity. This soil is wet in seasons of excessive rainfall. The available subsoil phosphorus is medium, and the available subsoil potassium is very low. Unless limed, the surface layer is strongly acid. Surface runoff is slow. Organic matter content in the surface layer is moderate.

This soil is suited to corn and soybeans. It is well suited to grasses and legumes for hay and pasture. This soil is also suited to trees.

Subsurface drainage may make field operations more timely in years of above normal rainfall. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

If this soil is used for pasture, overgrazing the pasture or grazing when the soil is too wet causes surface compaction and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed.

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 slightly convex, narrow upland divides. Individual areas are usually quite long and narrow. They are often more than one-half mile long but only a few hundred feet wide. Areas of this soil commonly are 40 to 60 acres in size.

Typically, the surface layer is very dark gray silt loam about 9 inches thick. The subsurface layer is dark grayish brown silt loam about 3 inches thick. The subsoil extends to a depth of 60 inches or more. It is brown silty clay loam in the upper part, yellowish brown silty clay loam in the middle part, and mottled light brownish gray and yellowish brown silty clay loam in the lower part. In some small, nearly level areas the surface layer is thicker. At the head of some drainageways the soil has a mottled subsoil and is not as well drained.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is medium, and the available subsoil potassium is very low. Unless limed, the surface layer is generally medium acid. Surface runoff is slow or medium. Organic matter content of the surface layer is moderate.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent soil loss. Some areas are well suited to contouring and terracing because of the long, uniform slopes. With terraces this soil can be planted to row crops more often than with most other conservation practices. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when this soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during the wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIe.

76C2—Ladoga silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on the edge of convex, narrow upland divides and on side slopes. Individual areas are usually quite long, narrow, and irregular in shape. Most areas of this soil are commonly one-half mile or more long and only a few hundred feet wide. Areas of this soil are 20 to 40 acres in size.

Typically, the surface layer is very dark grayish brown or dark grayish brown silt loam 4 to 7 inches thick. The subsoil extends to a depth of 60 inches or more. It is brown silty clay loam in the upper part, yellowish brown silty clay loam in the middle part, and mottled light brownish gray and yellowish brown silty clay loam in the lower part. In some areas the surface layer is silty clay loam.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is medium, and the available subsoil potassium is very low. Unless limed, the surface layer is generally medium acid. Surface runoff is medium. Organic matter content in the surface layer is moderate.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. This soil is also suited to trees. A few small areas remain in native hardwoods.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent soil loss. Some areas are well suited to contouring and terracing. With terraces this soil can be planted to row crops more often than with most other conservation practices. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when this soil is wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed.

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 on convex upland side slopes. Individual areas are irregular in shape and are generally rather long and narrow. Areas of this soil are 15 to 30 acres in size.

Typically, the surface layer is very dark grayish brown or dark grayish brown silt loam 3 to 6 inches thick. The subsoil extends to a depth of 60 inches or more. It is brown silty clay loam in the upper part, yellowish brown silty clay loam in the middle part, and mottled light brownish gray and yellowish brown silty clay loam in the lower part. In some areas the surface layer is silty clay loam. In some areas the subsoil as well as the subsurface layer has been mixed with the surface layer. In small areas at the head of drainageways the subsoil is gray and more mottled.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is medium, and the available subsoil potassium is very low. Unless limed, the surface layer is generally medium acid. Surface runoff is medium or rapid. Organic matter content in the surface layer is moderate.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. This soil is well suited to trees.

If this soil is cultivated, there is a hazard of further erosion. Minimum tillage helps prevent excessive soil loss. Some areas are well suited to contouring and terracing. With terraces this soil can be planted to row

crops more often than with other conservation practices. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to maintain soil tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed.

This soil is in capability subclass IIIe.

80B—Clinton silt loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on narrow, convex upland divides and the upper part of side slopes. Individual areas are long, narrow, and irregular in shape. They are commonly more than one-half mile long and 10 to 30 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 5 inches thick. The subsurface layer is brown silt loam about 3 inches thick. The subsoil extends to a depth of about 62 inches. It is brown silty clay loam in the upper part, yellowish brown silty clay loam in the middle part, and light brownish gray silty clay loam in the lower part. The substratum is yellowish brown friable silty clay loam. In cultivated areas, plowing has mixed some of the subsurface layer with the surface layer, forming a dark grayish brown plow layer 7 to 9 inches thick. In some small areas at the heads of drainageways the soil has a mottled subsoil and is not as well drained.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is high, and the available subsoil potassium is very low. Unless limed, the surface layer is strongly acid. Surface runoff is slow or medium. Organic matter content in the surface layer is moderately low.

This soil is well suited to corn, soybeans, small grains, and legumes for hay and pasture. This soil is also well suited to trees. A few small areas remain in native hardwoods.

If the soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent soil loss. Many areas have slopes that are long enough and smooth enough to be terraced and farmed on the contour. With terraces this soil can be planted to row crops more often than with most other conservation practices. Returning crop residue to the soil or regularly adding other organic material improves fertility, reduces crusting, increases water infiltration, and helps to maintain good tilth.

The use of this soil for pasture or hay is also effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep the pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed by site preparation, prescribed burning, or spraying and cutting.

This soil is in capability subclass IIe.

80C2—Clinton silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on tops and sides of long, convex ridges. Individual areas are long, narrow, and irregular in shape. They are usually 10 to 30 acres in size.

Typically, the surface layer is grayish brown silt loam about 5 inches thick. The subsoil extends to a depth of about 60 inches. It is brown silty clay loam in the upper part, yellowish brown silty clay loam in the middle part, and light brownish gray silty clay loam in the lower part. The substratum is yellowish brown silty clay loam. In places, the eroded surface layer has been mixed with some of the subsoil and the plow layer is brown silty clay loam. In uneroded areas of pasture and woodland the surface layer is very dark gray silt loam.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is high, and the available subsoil potassium is very low. Unless limed, the surface layer is strongly acid. Surface runoff is medium. Organic matter content in the surface layer is moderately low.

This soil is suited to corn, soybeans, small grains, and legumes for hay and pasture. This soil is well suited to trees.

If this soil is cultivated, there is a hazard of further erosion. Minimum tillage helps prevent excessive soil loss. In a few areas slopes are long enough and smooth enough to be terraced and farmed on the contour. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases water infiltration.

The use of this soil for pasture or hay is also effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, excessive runoff, and poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep the pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed by site preparation, prescribed burning, or spraying and cutting.

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 usually in bands around side slopes but in some places is on the crests of narrow ridges. Individual areas are long, narrow, and irregular in shape and usually are 10 to 30 acres in size.

Typically, the original surface layer has been mixed with the subsurface layer and some subsoil. The present surface layer is brown silt loam or silty clay loam. The subsoil extends to a depth of about 48 inches. It is brown silty clay loam in the upper part, yellowish brown silty clay loam in the middle part, and light brownish gray silty clay loam in the lower part. The substratum is yellowish brown silty clay loam. In most uneroded wooded areas, a thin layer of leaf litter overlies a thin, very dark grayish brown silt loam surface layer.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is high, and the available subsoil potassium is very low. Unless limed, the surface layer is strongly acid. Surface runoff is medium or rapid. Organic matter content in the surface layer is moderately low to low.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. This soil is well suited to trees.

If this soil is cultivated, there is a hazard of further erosion. Minimum tillage helps prevent excessive soil loss. Grassed waterways are needed to prevent the formation of gullies where water concentrates. In many areas slopes are long enough and uniform enough to be terraced and farmed on the contour. With terraces this soil can be planted to row crops more often than with most other conservation practices. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain soil tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed by site preparation, prescribed burning, or spraying and cutting.

This soil is in capability subclass IIIe.

88—Nevin silty clay loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on broad second bottoms a few feet above the flood plain. Individual areas are roughly oval in shape and are 5 to 30 acres in size.

Typically, the surface layer is black, very dark brown, and very dark grayish brown silty clay loam about 20 inches thick. The subsoil extends to a depth of 60 inches or more. It is dark grayish brown silty clay loam in the upper part; dark gray, dark yellowish brown, and grayish brown silty clay loam in the middle part; and light brownish gray silty clay loam in the lower part. In some areas on low benches of local alluvium, the surface layer is 30 inches or more thick. In some areas the soil has a silt loam surface layer, has gray silt coatings or platy structure in the subsurface layer, and is more olive or gray colored in the subsoil.

This soil has moderate permeability and very high available water capacity. The available subsoil phosphorus is medium, and the available subsoil potassium is high. Unless limed, the surface layer is medium acid. Surface runoff is slow. Organic matter content in the surface layer is high.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

In some areas properly placed diversion terraces protect this soil from siltation. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

If this soil is used for pasture, overgrazing the pasture or grazing when the soil is too wet causes surface compaction and poor tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability class I.

93D2—Shelby-Adair complex, 9 to 14 percent slopes, moderately eroded. These moderately sloping, moderately well drained and somewhat poorly drained soils are in bands along the lower part of valley sides. Individual areas are irregular in shape and are 5 to 20 acres in size. The Shelby soil makes up 60 percent of the complex and the Adair soil makes up 40 percent.

Typically, the surface layer of the Shelby soil is very dark grayish brown and brown loam about 8 inches thick. The subsoil extends to a depth of about 42 inches. It is brown and dark brown clay loam in the upper part and yellowish brown clay loam in the lower part. The substratum is yellowish brown loam.

The Shelby soil has moderately slow permeability and high available water capacity. The available subsoil phosphorus is low, and the available subsoil potassium is high. Unless limed, the surface layer is medium acid. Surface runoff is medium to rapid. Organic matter content in the surface layer is moderate.

Typically, the surface layer of the Adair soil is very dark grayish brown silty clay loam about 6 inches thick. The subsoil extends to a depth of about 60 inches. It is dark brown silty clay loam in the upper part, mottled multicolored clay loam in the middle part, and mottled

light brownish gray, brown, and strong brown clay loam in the lower part.

The Adair soil has slow permeability and high available water capacity. The available subsoil phosphorus is very low, and the available subsoil potassium is very low to low. Unless limed, the surface layer is typically slightly acid. Surface runoff is medium to rapid. Organic matter content in the surface layer is moderate.

These soils are moderately well suited to corn, soybeans, and small grains. They are better suited to grasses and legumes for hay and pasture and to trees.

If these soils are cultivated, there is a hazard of further erosion. Minimum tillage and grassed waterways help prevent excessive soil loss. In some places contouring is beneficial. Terracing is only moderately satisfactory because of slope, the firm subsoil, and the moderately slow and slow permeability. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain soil tilth.

The use of these soils for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed.

This complex is in capability subclass IVe.

94D2—Caleb-Mystic loams, 9 to 14 percent slopes, moderately eroded. These strongly sloping, moderately well drained and somewhat poorly drained soils are on sides of high benches. Individual areas are long, narrow, and regular in shape and range from a few acres to 30 acres in size. The Caleb soil makes up 60 percent of the map unit and the Mystic soil 40 percent.

Typically, the surface layer of the Caleb soil is very dark grayish brown loam about 7 inches thick. The subsoil extends to a depth of 60 inches or more. It is dark yellowish brown and brown loam in the upper part, yellowish brown clay loam in the middle part, and strong brown, grayish brown, and yellowish brown sandy loam in the lower part.

The Caleb soil has moderately slow permeability and moderate available water capacity. The available subsoil phosphorus and potassium are very low. Unless limed, the surface layer is medium acid. Surface runoff is medium or rapid. Organic matter content in the surface layer is moderate.

Typically, the surface layer of the Mystic soil is very dark grayish brown loam about 7 inches thick. The subsoil extends to a depth of 60 inches or more. It is yellowish brown silty clay loam in the upper part; yellowish red, reddish yellow, and yellowish brown clay loam in the middle part; and mottled yellowish red, brownish yellow, and strong brown clay loam in the lower part.

The Mystic soil has slow permeability and high available water capacity. The available subsoil phosphorus and potassium are very low. Unless limed, the surface layer is medium acid. Surface runoff is medium or rapid. Organic matter content in the surface layer is moderate.

These soils are moderately well suited to corn, soybeans, and small grains. They are better suited to grasses and legumes for hay and pasture. These soils are also suited to trees. A few areas are reverting to timber.

If these soils are cultivated, there is a hazard of further erosion. Minimum tillage and grassed waterways help prevent excessive soil loss. In some places contouring is beneficial. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain soil tilth.

The use of these soils for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if the competing vegetation is controlled or removed by site preparation, prescribed burning, or spraying and cutting.

This complex is in capability subclass IVe.

98—Huntsville silt loam, 0 to 2 percent slopes. This nearly level, moderately well drained or well drained soil is on low second bottoms above the present flood plain in most places. This soil is subject to occasional flooding. Individual areas are elongated and regular in shape and range from 5 to 30 acres in size.

Typically, the surface layer is very dark grayish brown, very dark brown, and dark brown silt loam about 29 inches thick. The substratum extends to a depth of 60 inches or more. It is brown silt loam in the upper part, brown loam in the middle part, and yellowish brown loam in the lower part. On some natural levees the soil has a fine sandy loam subsoil and gray silt coatings in the upper part of the subsoil.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is medium, and the available subsoil potassium is low. Unless limed, the surface layer is slightly acid. Surface runoff is slow. Organic matter content in the surface layer is high.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

Minimum tillage helps control erosion. In some areas

properly placed diversion terraces protect this soil from siltation. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to maintain good tilth.

If this soil is used for pasture, overgrazing the pasture or grazing when the soil is too wet causes surface compaction and poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability class I.

119—Muscatine silty clay loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on broad upland flats. Individual areas are roughly oval in shape and 10 to 30 acres in size.

Typically, the surface layer is very dark gray, very dark grayish brown, and dark grayish brown silty clay and silty clay loam about 25 inches thick. The subsoil extends to a depth of about 49 inches. It is grayish brown silty clay loam in the upper part and yellowish brown silty clay loam in the lower part. The substratum is olive silty clay loam. In a few small depressions the soil dries slowly during wet periods.

This soil has moderate permeability and very high available water capacity. The available subsoil phosphorus is low, and the available subsoil potassium is very low. Unless limed, the surface layer is medium acid. Surface runoff is slow. Organic matter content in the surface layer is high.

This soil is well suited to corn, soybeans, and small grains. It is also well suited to grasses and legumes for hay and pasture.

Subsurface drainage may make field operations more timely in years of above normal rainfall. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to maintain good tilth.

If this soil is used for pasture, overgrazing the pasture or grazing when the soil is too wet causes surface compaction and poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep 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 upland ridgetops. Individual areas are irregular in shape and 10 to 80 acres in size.

Typically, the surface layer is very dark brown, very dark grayish brown, and dark brown silty clay loam about 17 inches thick. The subsoil extends to a depth of about 43 inches. It is brown silty clay loam in the upper part, dark yellowish brown and yellowish brown silty clay loam in the middle part, and dark yellowish brown silty clay loam in the lower part. The substratum is yellowish brown silty clay loam.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is medium, and the available subsoil potassium is very low. Unless limed, the surface layer is strongly acid. Surface runoff is slow or medium. Organic matter content in the surface layer is moderate.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent excessive soil loss. Most areas are well suited to contouring and terracing because of the uniform slopes. With terraces this soil can be planted to row crops more often than with most other conservation practices. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIe.

120C2—Tama silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on long, slightly convex side slopes. Individual areas are irregular in shape and 10 to 70 acres in size.

Typically, the surface layer is dark brown or very dark brown silty clay loam about 3 to 6 inches thick and has brown mottles. The subsoil extends to a depth of about 40 inches. It is brown silty clay loam in the upper part, dark yellowish brown and yellowish brown silty clay loam in the middle part, and dark yellowish brown silty clay loam in the lower part. The substratum is yellowish brown light silty clay loam. In some small areas the soil has a very dark brown surface layer more than 7 inches thick.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is medium, and the available subsoil potassium is very low. Unless limed, the surface layer is strongly acid. Surface runoff is medium. Organic matter content in the surface layer is moderate.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of further erosion. Minimum tillage helps prevent excessive soil loss. Most areas are well suited to contouring and terracing because of the long, uniform slopes. With terraces this soil can be planted to row crops more often than

with other conservation practices. Returning crop residue to the soil or regularly adding other organic material improves fertility and soil tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep 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 and smooth side slopes. Individual areas are parallel to drainageways and usually several hundred feet wide. They are long and irregular in shape and are 10 to 80 acres in size.

Typically, the surface layer is dark brown or very dark brown silty clay loam 3 to 6 inches thick, and has brown mottles. The subsoil extends to a depth of about 40 inches. It is brown silty clay loam in the upper part, dark yellowish brown and yellowish brown silty clay loam in the middle part, and dark yellowish brown silty clay loam in the lower part. The substratum is yellowish brown silty clay loam.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is medium, and the available subsoil potassium is very low. Unless limed, the surface layer is strongly acid. Surface runoff is medium or rapid. Organic matter content of the surface layer is moderate.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of further erosion. Minimum tillage helps prevent excessive soil loss. Most areas are well suited to contouring and terracing because of the long, uniform slopes. With terraces this soil can be planted to row crops more often than with most other conservation practices. Returning crop residue to the soil or regularly adding other organic material improves fertility and soil tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIIe.

130—Belinda silt loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on flat but rather narrow upland divides. Some areas are ponded for short periods. Individual areas are regular in shape and 10 to 50 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is dark gray and dark grayish brown silt loam about 8 inches thick. The subsoil extends to a depth of about 54 inches. It is dark gray and dark grayish brown silty clay in the upper part, grayish brown silty clay in the middle part, and olive gray and light olive gray silty clay loam in the lower part. The substratum is light olive gray silty clay loam. In a few small areas the soil is slowly permeable and the drainage problem is less severe.

This soil has very slow permeability and moderately high available water capacity. The available subsoil phosphorus is low, and available subsoil potassium is very low. Unless limed, the surface layer is slightly acid. Surface runoff is very slow. Organic matter content in the surface layer is moderate.

If properly drained, this soil is suited to corn and soybeans. It is also suited to grasses and legumes for hay and pasture. The occasional ponding drowns out crops in some years.

Open ditches may be needed to successfully drain all areas. Small isolated areas are left idle in wet years. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain soil tilth.

If this soil is used for pasture or hay, overgrazing the pasture or grazing when the soil is too wet causes surface compaction and poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use in wet periods keep pasture and soil in good condition.

This soil is in capability subclass IIIw.

131B—Pershing silt loam, 2 to 5 percent slopes. This gently sloping, somewhat poorly drained or moderately well drained soil is on slightly convex, narrow upland divides. Individual areas are usually quite long and narrow. They are often one-half mile or more long and only a few hundred feet wide. Areas of this soil are commonly 40 to 60 acres in size.

Typically, the surface layer is very dark gray and very dark grayish brown silt loam about 7 inches thick. The subsurface layer is dark grayish brown silt loam about 2 inches thick. The subsoil extends to a depth of 60 inches or more. It is dark grayish brown and grayish brown silty clay loam in the upper part, grayish brown silty clay loam and silty clay in the middle part, and light brownish gray silty clay loam in the lower part. In some small nearly level areas the subsoil is more gray and in some moderately eroded areas the surface layer is mottled dark grayish brown and very dark grayish brown.

This soil has slow permeability and high available water capacity. The available subsoil phosphorus is high

and the available subsoil potassium is very low. Unless limed, the surface layer is slightly acid. Surface runoff is medium. Organic matter content in the surface layer is moderate.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent soil loss. Some areas are well suited to contouring and terracing because of the uniform slopes. With terraces this soil can be planted to row crops more often than with most other conservation practices. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIe.

131C2—Pershing silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, somewhat poorly drained or moderately well drained soil is on side slopes at the edge of convex, narrow upland divides. Individual areas are usually quite long, narrow, and irregular in shape. Areas of this soil are 15 to 30 acres in size.

Typically, the surface layer is very dark grayish brown or dark grayish brown silt loam about 4 to 7 inches thick. The subsoil extends to a depth of about 50 inches. It is dark grayish brown and grayish brown silty clay loam in the upper part, grayish brown silty clay loam and silty clay in the middle part, and light brownish gray silty clay loam in the lower part. In some areas the surface layer is thicker.

This soil has slow permeability and high available water capacity. The available subsoil phosphorus is high, and available subsoil potassium is very low. Unless limed, the surface layer is slightly acid. Surface runoff is medium. Organic matter content in the surface layer is moderate.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. This soil is also suited to trees.

If this soil is cultivated, there is a hazard of further erosion. Minimum tillage helps prevent soil loss. Some areas are well suited to contouring and terracing because of the uniform slopes. With terraces this soil can be planted to row crops more often than with most other conservation practices. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed by site preparation, prescribed burning, or spraying and cutting.

This soil is in capability subclass IIIe.

132B—Weller silt loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on narrow, convex upland divides and the upper part of side slopes. Individual areas are long, narrow, and irregular in shape. They are commonly more than one-half mile long and 10 to 20 acres in size.

Typically, the surface layer is grayish brown silt loam about 8 inches thick. The subsurface layer is grayish brown and pale brown silt loam about 2 inches thick. The subsoil extends to a depth of about 55 inches. It is brown silty clay loam in the upper part, grayish brown and strong brown silty clay in the middle part, and light brownish gray and light olive gray silty clay loam in the lower part. The substratum is light olive gray silty clay loam.

This soil has slow permeability and high available water capacity. The available subsoil phosphorus is medium, and the available subsoil potassium is very low. Unless limed, the surface layer is strongly acid. Surface runoff is medium. Organic matter content in the surface layer is moderately low.

This soil is suited to corn, soybeans, small grains, and legumes for hay and pasture. This soil is also suited to trees. A few small areas remain in native hardwoods.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent soil loss. Many areas have slopes that are long enough and smooth enough to be terraced and farmed on the contour. With terraces this soil can be planted to row crops more often than with most other conservation practices. Returning crop residue to the soil or regularly adding other organic materials improves fertility, reduces crusting, increases water infiltration, and helps maintain good tilth.

The use of this soil for pasture or hay is also effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep the pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is con-

trolled or remove by site preparation, prescribed burning, or spraying and cutting.

This soil is in capability subclass IIIe.

132C2—Weller silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on convex tops and sides of ridges. Individual areas are long, narrow, and irregular in shape. They are 5 to 15 acres in size.

Typically, the surface layer is grayish brown and dark grayish brown silt loam about 3 to 6 inches thick. The subsoil extends to a depth of about 55 inches. It is brown silty clay loam in the upper part, grayish brown and strong brown silty clay in the middle part, and light brownish gray and light olive gray silty clay loam in the lower part. The substratum is light olive gray silty clay loam. In a few areas the surface layer is light silty clay loam. In some uneroded areas the surface layer is very dark grayish brown or dark grayish brown.

This soil has slow permeability and high available water capacity. The available subsoil phosphorus is medium, and the available subsoil potassium is very low. Unless limed, the surface layer is strongly acid. Surface runoff is medium. Organic matter content in the surface layer is low.

This soil is suited to corn, soybeans, small grains, and legumes for hay and pasture. This soil is well suited to trees.

If this soil is cultivated, there is a hazard of further erosion. Minimum tillage helps prevent excessive soil loss. A few areas have slopes that are long enough and smooth enough to be terraced and farmed on the contour. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases water infiltration.

The use of this soil for pasture or hay is also effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, excessive runoff, and poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed by site preparation, prescribed burning, or spraying and cutting.

This soil is in capability subclass IIIe.

133—Colo silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on first bottoms and in drainageways. This soil is subject to flooding. Individual areas are generally long and narrow and are 20 to 40 acres in size.

Typically, the surface layer is very dark brown and black silty clay loam about 46 inches thick. The substratum is very dark gray silty clay loam. Some small areas have several inches of very dark grayish brown silt loam overwash. In some small areas the surface layer is only 30 inches or less thick.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is medium, and the available subsoil potassium is very low. Unless limed, the surface layer is medium acid. Surface runoff is slow. Organic matter content of the surface layer is high.

This soil is well suited to corn, soybeans, and grasses and legumes for hay and pasture if the soil is drained and if flooding is not too frequent. Areas that are flooded too often or that are cut up by old stream channels are generally used for pasture or hay.

Spring plowing and planting are sometimes delayed by flooding. Artificial drainage lowers the water table and improves the timeliness of field operations. In places diversion terraces help protect the soil from flooding. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

If this soil is used for pasture or hay, overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIw.

133B—Colo silty clay loam, 2 to 5 percent slopes. This gently sloping, poorly drained soil is at the base of valley sides and in some drainageways. Individual areas are long and narrow and range from 5 to 10 acres in size.

Typically, the surface layer is very dark brown and black silty clay loam about 46 inches thick. The substratum is very dark gray silty clay loam. In some areas there is an accumulation of clay in the subsoil. In some areas the soil has layers of clay loam rather than silty clay loam.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is medium, and the available subsoil potassium is very low. Unless limed, the surface layer is medium acid. Surface runoff is medium. Organic matter content in the surface layer is high.

This soil is suited to corn, soybeans, and grasses and legumes for hay and pasture.

Artificial drainage lowers the water table and improves the timeliness of field operations. Diversion terraces protect the soil from runoff from higher lying soils. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

If this soil is used for pasture or hay, overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIw.

133+—Colo silt loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on wide flat bottom lands and in drainageways. These soils are subject to flooding. Individual areas are long and narrow in most places and are 10 to 30 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 7 to 18 inches thick. The next layer is black silty clay loam about 40 inches thick. The substratum is very dark gray silty clay loam.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is medium, and the available subsoil potassium is very low. Unless limed, the surface layer is medium acid. Surface runoff is slow. Organic matter content of the surface layer is moderate.

If drained, this soil is suited to corn, soybeans, and grasses and legumes for hay and pasture.

Spring plowing and planting are sometimes delayed by flooding. This soil is generally not as wet as Colo soils that have no overwash, but it benefits from artificial drainage. Because the surface layer is silt loam, plowing and preparation of the seedbed is easier in this soil than on other Colo soils. Diversion terraces above this soil protect it from siltation. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

If this soil is used for pasture or hay, overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting 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 upland ridgetops. Individual areas are irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is very dark gray silt loam about 8 inches thick. The subsurface layer is dark grayish brown silt loam about 3 inches thick. The subsoil extends to a depth of 60 inches or more. It is brown silty clay loam in the upper part, yellowish brown silty clay loam in the middle part, and mottled yellowish brown and grayish brown silt loam and silty clay loam in the lower part.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is medium, and available subsoil potassium is very low. Unless limed, the surface layer is slightly acid. Surface runoff is slow or medium. Organic matter content in the surface layer is moderate.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent soil loss. Some areas are well suited to contouring and terracing because of the uniform slopes. With terraces this soil can be planted to row crops more often than with most other conservation practices. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

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 tops and convex sides of upland ridges. Individual areas are irregular in shape and range from 5 to 25 acres in size.

Typically, the surface layer is very dark gray silt loam about 3 to 6 inches thick. The subsurface layer is dark grayish brown silt loam about 3 inches thick. The subsoil extends to a depth of 60 inches or more. It is brown silty clay loam in the upper part, yellowish brown silty clay loam in the middle part, and mottled yellowish brown and grayish brown silt loam and silty clay loam in the lower part.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is medium, and the available subsoil potassium is very low. Unless limed, the surface layer is slightly acid. Surface runoff is medium. Organic matter content in the surface layer is moderate.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. This soil is suited to trees.

If this soil is cultivated, there is a hazard of further erosion. Minimum tillage helps prevent soil loss. Some areas are well suited to contouring and terracing because of the long slopes. With terraces this soil can be planted to row crops more often than with most other conservation practices. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at ap-

propriate times, and restricting use during wet periods help keep pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed by site preparation, prescribed burning, or spraying and cutting.

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 on convex side slopes on uplands. Individual areas are irregular in shape and range from 5 to 30 acres in size.

Typically, the surface layer is very dark gray silt loam about 3 to 6 inches thick. The subsurface layer is dark grayish brown silt loam about 3 inches thick. The subsoil extends to a depth of 60 inches or more. It is brown silty clay loam in the upper part, yellowish brown silty clay loam in the middle part, and mottled yellowish brown and grayish brown silt loam and silty clay loam in the lower part.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is medium, and the available subsoil potassium is very low. Unless limed, the surface layer is slightly acid. Surface runoff is medium or rapid. Organic matter content in the surface layer is moderate.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. This soil is also suited to trees.

If this soil is cultivated, there is a hazard of further erosion. Minimum tillage helps prevent excessive soil loss. Some areas are suited to contouring and terracing. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain soil tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed by site preparation, prescribed burning, or spraying and cutting.

This soil is in capability subclass IIIe.

163B—Fayette silt loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on upland ridgetops. Individual areas are small and irregular in shape and range from 10 to 35 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown silt loam. The subsoil extends to a depth of 60 inches or more. It is dark yellowish brown silty clay loam in the upper part and dark brown and yellowish brown silty clay loam in the lower part. The substratum is mottled yellowish brown and light brownish gray silty clay loam.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is high and the available subsoil potassium is very low. Unless limed, the surface layer is slightly acid. The surface runoff is slow or medium. Organic matter content in the surface layer is moderate.

This soil is suited to corn, soybeans, small grains, and legumes for hay and pasture. This soil is well suited to trees. A few small areas remain in native hardwoods.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent soil loss. In many areas slopes are long enough and smooth enough to be terraced and farmed on the contour. Returning crop residue to the soil or regularly adding other organic material improves fertility, reduces crusting, increases water infiltration, and helps maintain good tilth.

The use of this soil for pasture or hay is also effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, excessive runoff, and poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep the pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed by site preparation, prescribed burning, or spraying and cutting.

This soil is in capability subclass IIe.

163C2—Fayette silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on tops and convex sides of upland ridges. Individual areas are long, narrow, and irregular in shape and range from 10 to 30 acres in size.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil extends to a depth of about 48 inches. It is dark yellowish brown silty clay loam in the upper part and yellowish brown silty clay loam in the lower part. The substratum is mottled yellowish brown and light brownish gray silty clay loam. In some small areas the soil has a thin very dark gray surface layer and a dark grayish brown subsurface layer. There are also a few small spots of sand.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is high, and the available subsoil potassium is very low. Unless limed, the surface layer is slightly acid. Surface runoff is medium. Organic matter content of the surface layer is moderately low.

This soil is suited to corn, soybeans, small grains, and legumes for hay and pasture. This soil is well suited to trees.

If the soil is cultivated, there is a hazard of further erosion. Minimum tillage helps prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases water infiltration.

The use of this soil for pasture or hay is also effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, excessive runoff, and poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed by site preparation, prescribed burning, or spraying and cutting.

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 convex upland side slopes. Individual areas are irregular in shape and range from 5 to 20 acres in size.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil extends to a depth of about 40 inches. It is dark yellowish brown silty clay loam in the upper part and yellowish brown silty clay loam in the lower part. The substratum is mottled yellowish brown and light brownish gray silty clay loam.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is high, and the available subsoil potassium is very low. Unless limed, the surface layer is slightly acid. Surface runoff is medium or rapid. Organic matter content in the surface layer is moderately low.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. This soil is well suited to trees.

If this soil is cultivated, there is a hazard of further erosion. Minimum tillage helps prevent excessive soil loss. Grassed waterways are needed to prevent formation of gullies where water concentrates. In many areas slopes are long enough and uniform enough to be terraced and farmed on the contour. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain soil tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed by site preparation, prescribed burning, or spraying and cutting.

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 on highly dissected uplands. Individual areas are irregular in shape and 15 to 30 acres in size.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil extends to a depth of about 40 inches. It is dark yellowish brown silty clay loam in the upper part, and yellowish brown silty clay loam in the lower part. The substratum is mottled yellowish brown and light brownish gray silty clay loam.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is high, and the available subsoil potassium is very low. Unless limed, the surface layer is slightly acid. Surface runoff is rapid. Organic matter content in the surface layer is moderately low.

This soil is moderately well suited to an occasional row crop in rotation with small grains and grasses and legumes for hay and pasture. It is better suited to continuous hay and pasture. This soil is well suited to trees. A few small areas remain in native hardwoods.

If this soil is cultivated, there is a severe hazard of erosion. Minimum tillage helps prevent soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increased runoff, and poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed by site preparation, prescribed burning, or spraying and cutting.

This soil is in capability subclass IVe.

163F2—Fayette silt loam, 18 to 25 percent slopes, moderately eroded. This steep, well drained soil is on dissected side slopes on highly dissected uplands. Individual areas are irregular in shape and range from 5 to 15 acres in size.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil extends to a depth of about 40 inches. It is dark yellowish brown silty clay loam in the upper part, and yellowish brown silty clay loam in the lower part. The substratum is mottled yellowish brown and light brownish gray silty clay loam.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is high, and the available subsoil potassium is very low. Unless limed, the surface layer is slightly acid. Surface runoff is rapid or very rapid. Organic matter content in the surface layer is low.

This soil is poorly suited to corn, soybeans, and small grains and only moderately well suited to pasture and hay. This soil is suited to trees. A few small areas remain in native hardwoods.

Operation of farm machinery is difficult because of the steepness of slope and the presence of gullies and waterways. If this soil is cultivated, there is a severe hazard of further erosion. Crops that require tillage should be grown only in reestablishing grasses for hay and pasture. Minimum tillage helps prevent excessive soil loss. Waterways and gullies can be shaped and seeded. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increased runoff, and poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed by site preparation, prescribed burning, or spraying and cutting.

This soil is in capability subclass VIe.

179D2—Gara loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained or well drained soil is on the lower part of side slopes on dissected uplands. Individual areas are long, narrow, and irregular in shape and range from 5 to 15 acres in size.

Typically, the surface layer is very dark grayish brown loam about 3 to 6 inches thick. The subsoil extends to a depth of about 48 inches. It is brown loam in the upper part, dark yellowish brown or yellowish brown loam and clay loam in the middle part, and coarsely mottled light brownish gray and yellowish brown loam in the lower part. The substratum is coarsely mottled light brownish gray and yellowish brown clay loam. In some places this soil has a clay loam surface layer.

This soil has moderately slow permeability and high available water capacity. The available subsoil phosphorus and potassium are very low. Unless limed, the surface layer is medium acid. Surface runoff is medium or rapid. Organic matter content in the surface layer is moderate.

This soil is suited to corn, soybeans, and small grains. It is better suited to grasses and legumes for hay and pasture. This soil is well suited to trees. A few areas are reverting to timber.

If this soil is cultivated, there is a hazard of further erosion. Minimum tillage and grassed waterways help prevent excessive erosion. Terracing is only moderately satisfactory because of the slope, firm subsoil, and moderately slow permeability. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain soil tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed by site preparation, prescribed burning, or spraying and cutting.

This soil is in capability subclass IVe.

179E2—Gara loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, moderately well drained or well drained soil is on convex sides of valleys in strongly dissected uplands. Individual areas are narrow irregular bands and range from 5 to 30 acres in size.

Typically, the surface layer is very dark grayish brown loam about 3 to 6 inches thick. The subsoil extends to a depth of about 42 inches. It is brown loam in the upper part, dark yellowish brown or yellowish brown loam and clay loam in the middle part, and coarsely mottled light brownish gray and yellowish brown loam in the lower part. The substratum is coarsely mottled light brownish gray and yellowish brown clay loam. In some places the subsurface layer has been mixed with the surface layer.

This soil has moderately slow permeability and high available water capacity. The available subsoil phosphorus and potassium are very low. Unless limed, the surface layer is medium acid. Surface runoff is rapid. Organic matter content in the surface layer is moderate.

Because this soil is too steep for use of ordinary farm machinery, it is not suited to corn, soybeans, or small grains. It is suited to grasses and legumes for hay and pasture. This soil is also suited to trees. A few small areas remain in native hardwoods.

If this soil is cultivated, there is a severe hazard of erosion. This soil is also too steep for construction of terraces and has an unfavorable firm subsoil, is moderately slowly permeable, and is difficult to revegetate when the subsoil is exposed.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition. Returning crop residue to the soil or regularly adding other organic material helps improve fertility and maintain soil tilth.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is con-

trolled or removed by site preparation, prescribed burning, or spraying and cutting.

This soil is in capability subclass VIe.

179F—Gara loam, 18 to 25 percent slopes. This steep, moderately well drained or well drained soil is on convex side slopes on uplands. Individual areas are long, narrow, and irregular in shape and range from 10 to 30 acres in size.

Typically, the surface layer is very dark brown loam about 7 inches thick. The subsurface layer is dark grayish brown loam about 4 inches thick. The subsoil extends to a depth of about 41 inches. It is brown loam in the upper part, dark yellowish brown or yellowish brown loam and clay loam in the middle part, and coarsely mottled light brownish gray and yellowish brown loam in the lower part. The substratum is coarsely mottled light brownish gray and yellowish brown clay loam. In some areas the surface layer is very dark grayish brown loam about 3 to 6 inches thick.

This soil has moderately slow permeability and high available water capacity. The available subsoil phosphorus and potassium are very low. Unless limed, the surface layer is medium acid. Surface runoff is rapid or very rapid. Organic matter content in the surface layer is moderate.

This soil is not suited to corn, soybeans, or small grains. It is better suited to permanent pasture. This soil is suited to trees. A few small areas remain in native hardwoods.

If this soil is cultivated, there is a severe hazard of erosion.

The use of this soil for pasture is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition. Renovation of pasture is difficult because the soil is steep. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain soil tilth.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed by site preparation, prescribed burning, or spraying and cutting.

This soil is in capability subclass VIIe.

185D—Bauer silt loam, 9 to 14 percent slopes. This strongly sloping, well drained or moderately well drained soil is on convex side slopes on uplands. Individual areas are long, narrow, and irregular in shape and range from 10 to 20 acres in size.

Typically, the surface layer is black and very dark grayish brown silt loam about 9 inches thick. The subsoil extends to a depth of about 20 inches. It is olive brown silty clay in the middle part, grayish brown and light olive silty clay in the middle part, and olive clay in the lower part. The substratum is multicolored clay shale.

This soil has very slow permeability and low available water capacity. The available subsoil phosphorus is very low, and the available subsoil potassium is low. Unless limed, the surface layer is medium acid. Surface runoff is medium or rapid. Organic matter content in the surface layer is moderate.

This soil is poorly suited to corn, soybeans, and small grains, but it is suited to grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent excessive soil loss. In many places contouring is beneficial. This soil is not suitable for terraces because of the clay shale substratum. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IVe.

185D2—Bauer silt loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained or moderately well drained soil is on convex side slopes on uplands. Individual areas are long, narrow, and irregular in shape and usually range from 10 to 30 acres in size.

Typically, the surface layer is very dark gray silt loam about 3 to 6 inches thick. The subsoil extends to a depth of about 20 inches. It is olive brown silty clay loam in the upper part, grayish brown and light olive silty clay in the middle part, and olive clay in the lower part. The substratum is multicolored clay shale.

This soil has very slow permeability and low available water capacity. The available subsoil phosphorus is very low, and the available subsoil potassium is low. Unless limed, the surface layer is medium acid. Surface runoff is medium or rapid. Organic matter content in the surface layer is moderate.

This soil is poorly suited to corn, soybeans, and small grains, but it is suited to grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent excessive soil loss. In many places contouring is beneficial. This soil is not suitable for terraces because of the shallowness to the clay shale. The surface layer of this soil is lower in organic matter content and fertility than the surface layer of the slightly eroded Bauer soils. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion (fig. 12). Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IVe.

185E2—Bauer silt loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, well drained or moderately well drained soil is on convex side slopes on uplands. Individual areas are long, narrow, and irregular in shape and are usually from 20 to 40 acres in size.

Typically, the surface layer is very dark gray silt loam about 3 to 6 inches thick. The subsoil extends to a depth of about 20 inches. It is olive brown silty clay loam in the upper part, grayish brown and light olive silty clay in the middle part, and olive clay in the lower part. The substratum is multicolored clay shale.

This soil has very slow permeability and low available water capacity. The available subsoil phosphorus is very low, and the available subsoil potassium is low. Unless limed, the surface layer is medium acid. Surface runoff is rapid. Organic matter content in the surface layer is moderate.

This soil is poorly suited to corn, soybeans, and small grains, but it is suited to grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent excessive soil loss. In many places contouring is beneficial. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass VIe.

208—Landes loam, 0 to 2 percent slopes. This nearly level, well drained soil is on flood plains adjacent to the stream channel. This soil is subject to flooding. They are more undulating than other soils on the bottom lands. Areas range from 10 to 30 acres in size.

Typically, the surface layer is very dark grayish brown loam and fine sandy loam about 18 inches thick. The substratum is stratified dark grayish brown and light brownish gray fine sand and very dark grayish brown loam. In some areas the subsoil has brown mottles but the color of the mottles varies with the frequency of flooding.

Figure 12.—Pasture and hay are effective in controlling erosion on Bauer silt loam, 9 to 14 percent slopes, moderately eroded.

This soil has rapid permeability and low available water capacity. The available subsoil phosphorus and potassium are very low. These soils are neutral throughout the solum. Surface runoff is slow. Organic matter content in the surface layer is moderately low.

If this soil is protected from overflow, it is suited to corn, soybeans, and small grains. Most of the area of this soil is cultivated, but flooding is a hazard.

Properly placed diversions above this soil provides some protection from local runoff and reduces siltation. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to maintain good tilth.

If this soil is used for pasture or hay, overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increased runoff, and poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIw.

212—Kennebec silt loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on flood plains near river channels or adjacent to meander belts of stream valleys. This soil is subject to flooding during periods of heavy rainfall. Individual areas are long, wide, and regular in shape and range from 10 to 80 acres in size.

Typically, the surface layer is very dark gray and black silt loam grading to very dark grayish brown silty clay loam; it is about 44 inches thick. The substratum is dark grayish brown silty clay loam.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is low, and the available subsoil potassium is very low. Unless limed, the surface layer is slightly acid. Surface runoff is slow. Organic matter content in the surface layer is high.

This soil is well suited to corn, soybeans, and small grains. It is also suited to grasses and legumes for hay and pasture. Flooding damages crops in some years.

Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to maintain good tilth.

If this soil is used for pasture or hay, overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIw.

220—Nodaway silt loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on flood plains near the main channels of streams. This soil is subject to flooding during periods of heavy rainfall. Individual areas are long and commonly rather wide and regular in shape. They range from 10 to 80 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The substratum has layers of brown, very dark grayish brown, and pale brown silt loam with strata of fine sandy loam in the lower part. In some small areas there is a buried soil at a depth of less than 36 inches. In some small areas the soil has stratification that includes dark bands of silty clay loam several inches thick.

This soil has moderate permeability and very high available water capacity. The available subsoil phosphorus and potassium are medium. Unless limed, the surface layer is slightly acid. Surface runoff is slow. Organic matter content in the surface layer is moderate to moderately low.

This soil is suited to corn, soybeans, and small grains. It is also suited to grasses and legumes for hay and pasture. Flooding or recent deposition damages crops in some years.

Properly placed diversions above this soil provides some protection from local runoff and reduces siltation. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

If this soil is used for pasture or hay, overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

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, generally in coves at the heads of drainageways. Individual areas are rather regular in shape; for example, a few areas are long and narrow. Areas range from 3 to 10 acres in size.

Typically, the surface layer is very dark brown and very dark grayish brown silty clay loam about 11 inches thick. The subsoil extends to a depth of 60 inches or more. It is dark grayish brown and very dark grayish brown silty clay loam in the upper part, dark gray and gray silty clay in the middle part, and light gray silty clay loam in the lower part.

This soil has very slow permeability and high available water capacity. The available subsoil phosphorus is low, and the available subsoil potassium is low to medium. Unless limed, the surface layer is medium acid. Surface runoff is medium. Organic matter content in the surface layer is moderate.

This soil is moderately well suited to row crops in rotation with small grains and grasses and legumes for

hay and pasture. It is better suited to constant hay and pasture.

If this soil is cultivated, there is a hazard of further erosion. Minimum tillage helps prevent excessive soil loss. Interceptor drainage lines placed upslope from this soil reduce seepage. Contouring also helps prevent further erosion. Terracing is not satisfactory because of the firm subsoil and the very slow permeability. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

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 side slopes, generally in coves at the heads of drainageways. Individual areas are regular in shape; a few are long and narrow. Areas range from 3 to 10 acres in size.

Typically, the surface layer is very dark grayish brown silty clay loam about 3 to 7 inches thick. The subsoil extends to a depth of about 60 inches. It is dark grayish brown, very dark gray, and grayish brown silty clay loam in the upper part, dark gray and gray silty clay in the middle part, and light gray silty clay loam in the lower part.

This soil has very slow permeability and high available water capacity. The available subsoil phosphorus is low, and the available subsoil potassium is low to medium. Unless limed, the surface layer is medium acid. Surface runoff is medium. Organic matter content in the surface layer is moderate.

This soil is moderately well suited to occasional row crops in rotation with small grains and grasses and legumes for hay and pasture. It is better suited to constant hay and pasture.

If this soil is cultivated, there is a hazard of further erosion. Minimum tillage helps prevent excessive soil loss. Gullies and drainageways need to be reshaped and reseeded in places. Terracing is usually not satisfactory because of the firm subsoil and the very slow permeability. Interceptor drainage lines placed upslope from this soil generally reduces seepage. Contouring also helps prevent soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and soil tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IVw.

230C—Clearfield-Arispe silty clay loams, 5 to 9 percent slopes. These moderately sloping soils are on convex, and in some places concave, upper parts of side slopes near upland divides. Individual areas are long and irregular in shape and range from 5 to 15 acres in size. The Clearfield soil is typically on concave side slopes close to waterways and in small coves. The Arispe soil is on convex side slopes between waterways. The Clearfield soil makes up about 60 percent of the complex, and the Arispe soil makes up about 30 percent.

Typically, the surface layer of the Clearfield soil is very dark gray silty clay loam about 9 inches thick. The subsoil extends to a depth of about 46 inches. It is grayish brown silty clay loam in the upper part, olive gray and light gray silty clay loam in the middle part, and light gray silty clay loam in the lower part. The next layer is light gray clay with strong brown and yellowish brown mottles.

The Clearfield soil has moderately slow permeability in the upper part and very slow permeability in the lower part. Available water capacity is high. The available subsoil phosphorus and potassium are low. Unless limed, the surface layer is medium acid. Surface runoff is medium. The organic matter content is moderate.

Typically, the surface layer of the Arispe soil is very dark brown silty clay loam about 7 inches thick. The subsoil extends to a depth of about 45 inches. It is very dark grayish brown and dark grayish brown silty clay loam in the upper part, grayish brown and light brownish gray silty clay loam in the middle part, and light olive gray silty clay loam in the lower part. The substratum is light olive gray silty clay loam.

The Arispe soil has moderately slow permeability and high available water capacity. The available subsoil phosphorus is very low, and the available subsoil potassium is low. Unless limed, the surface layer is medium acid. Surface runoff is medium. Organic matter content in the surface layer is moderate.

These soils are suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If these soils are cultivated, there is a hazard of further erosion. Minimum tillage helps prevent excessive soil loss. Grassed waterways prevent the formation of gullies where water concentrates. In many places subsurface drainage is needed along the waterways to prevent excessive wetness. Many areas have slopes that are suitable for terracing and contour farming. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain soil tilth.

The use of these soils for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction,

increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This complex is in capability subclass IIIw.

230C2—Clearfield-Arispe silty clay loams, 5 to 9 percent slopes, moderately eroded. These moderately sloping soils are on convex, and in some places concave, upper parts of side slopes near the upland divides. Individual areas are long and irregular in shape and range from 5 to 30 acres in size. The Clearfield soil is on concave side slopes close to the waterways and in small coves. The Arispe soil is on convex side slopes between the waterways. The complex is about 60 percent Clearfield soil and 30 percent Arispe soil.

Typically, the surface layer of the Clearfield soil is very dark gray silty clay loam about 7 inches thick. The subsoil extends to a depth of about 46 inches. It is grayish brown silty clay loam in the upper part, olive gray and light gray silty clay loam in the middle part, and light gray silty clay loam in the lower part. The next layer is light gray clay with strong brown and yellowish brown mottles.

The Clearfield soil has moderately slow permeability in the upper part and very slow permeability in the lower part. Available water capacity is high. The available subsoil phosphorus and potassium are low. Unless limed, the surface layer is medium acid.

Surface runoff is medium. Organic matter content in the surface layer is moderate.

Typically, the surface layer of the Arispe soil is very dark brown silty clay loam about 7 inches thick. The subsoil extends to a depth of about 45 inches. It is very dark grayish brown and dark grayish brown silty clay loam in the upper part, grayish brown and light brownish gray silty clay loam in the middle part, and light olive gray silty clay loam in the lower part. The substratum is light olive gray silty clay loam.

The Arispe soil has moderately slow permeability and high available water capacity. The available subsoil phosphorus is very low, and the available subsoil potassium is low. Unless limed, the surface layer is medium acid. Surface runoff is medium. Organic matter content in the surface layer is moderate.

These soils are suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of further erosion. Minimum tillage helps prevent excessive soil loss. Grassed waterways are needed to prevent formation of gullies where water concentrates. Subsurface drainage is needed along the waterways to prevent excessive wetness. Many areas of these soils are suitable for terracing. With terraces this soil can be planted to row crops more often than with most other conservation practices. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain soil tilth.

The use of these soils for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This complex is in capability subclass IIIe.

248—Wabash silty clay loam, 0 to 2 percent slopes. This nearly level, very poorly drained soil is on wide bottom lands in depressional slack water areas. This soil is subject to flooding. Individual areas are 10 to 100 acres in size.

Typically, the surface layer is black silty clay loam and silty clay about 24 inches thick. The subsoil extends to a depth of about 50 inches. It is very dark gray silty clay. The substratum is dark gray silty clay.

This soil has very slow permeability and moderate available water capacity. The available subsoil phosphorus is high, and the available subsoil potassium is medium. Unless limed, the surface layer is medium acid. Surface runoff is very slow. Organic matter content in the surface layer is high.

This soil is suited to corn and soybeans if the soil is drained and if flooding is not too frequent.

Spring plowing and planting are sometimes delayed by flooding. Shallow surface ditches will drain the soil. The very slowly permeable subsoil does not permit adequate drainage by subsurface lines. Diversion terraces reduce flooding. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

If this soil is used for pasture or hay, overgrazing or grazing when the soil is too wet causes surface compaction and poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIIw.

273B—Olmitz loam, 2 to 5 percent slopes. This gently sloping, well drained to moderately well drained soil is on low, slightly concave foot slopes and alluvial fans that are downslope from moderately steep and steep clay loam glacial till soils. Individual areas are commonly long and narrow and are 3 to 10 acres in size.

Typically, the surface layer is black and very dark gray loam about 21 inches thick. The subsoil extends to a depth of more than 58 inches. It is very dark grayish brown clay loam in the upper part, dark brown clay loam in the middle part, and brown clay loam in the lower part. In some areas the subsoil is mottled with olive or grayish brown colors and the surface layer and subsoil are silt loam that is high in sand.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus and

potassium are very low. Unless limed, the surface layer is medium acid. Surface runoff is slow or medium. Organic matter content in the surface layer is high.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent soil loss. Diversion terraces protect this soil from runoff from higher lying soils. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep 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 in on low, slightly concave foot slopes that are downslope from moderately steep and steep clay loam glacial till soils. Individual areas are commonly long and narrow. They are 5 to 10 acres in size.

Typically, the surface layer is black and very dark gray loam about 21 inches thick. The subsoil extends to a depth of more than 58 inches. It is very dark grayish brown clay loam in the upper part, dark brown clay loam in the middle part, and brown clay loam in the lower part. In some small areas 18 to 20 inches of loamy surface soil overlies the clay loam.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus and potassium are very low. Unless limed, the surface layer is medium acid. Surface runoff is medium. Organic matter content in the surface layer is high.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent soil loss. Diversion terraces protect this soil from runoff from higher lying soils. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the soil or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep 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 upland divides. Individual areas are rather regular in shape, tending to oval. Areas are 20 to 300 acres in size.

Typically, the surface layer is black silty clay loam and very dark gray silty clay loam about 19 inches thick. The subsoil extends to a depth of 60 inches or more. It is very dark gray and dark gray silty clay loam in the upper part, grayish brown silty clay loam in the middle part, and mottled light gray, light olive gray, and strong brown silty clay loam in the lower part. The substratum is light gray silt loam.

This soil has moderately slow permeability and high available water capacity. This soil has a seasonal high water table, especially in spring. The available subsoil phosphorus and potassium are very low. Unless limed, the surface layer is slightly acid. Surface runoff is slow. Organic matter content in the surface layer is high.

This soil is well suited to corn, soybeans, and small grains. It is also well suited to grasses and legumes for hay and pasture.

Minimum tillage helps prevent soil blowing. Subsurface drainage makes field operations more timely in most years. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

If this soil is used for pasture, overgrazing the pasture or grazing when the soil is too wet causes surface compaction and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

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 wide divides. Individual areas are long and 1/8 to 1/4 mile wide. They are 10 to several hundred acres in size.

Typically, the surface layer is black and very dark grayish brown silty clay loam about 19 inches thick. The subsoil extends to a depth of 60 inches or more. It is dark grayish brown silty clay loam in the upper part, dark grayish brown and brown silty clay loam in the middle part, and mottled strong brown, light brownish gray, and light gray silty clay loam in the lower part. The substratum is mottled light gray and yellowish brown silty clay loam. In a few small areas the soil is poorly drained and has a grayer subsoil.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is medium, and the available subsoil potassium is very low. Unless limed, the surface layer is medium acid. Surface runoff is slow. Organic matter content in the surface layer is high.

This soil is well suited to corn, soybeans, and small grains. It is also well suited to grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent soil loss. In most places contouring is beneficial. In some places subsurface drainage makes field operations more timely in wet years. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increased runoff, and poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability class I.

281B—Otley silty clay loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on narrow ridgetops. Individual areas are generally long and irregular in shape. They are 5 to several hundred acres in size.

Typically, the surface layer is very dark brown and very dark grayish brown silty clay loam about 20 inches thick. The subsoil extends to a depth of about 46 inches. It is dark brown and brown silty clay loam in the upper part, brown silty clay loam in the middle part, and olive gray silty clay loam in the lower part. The substratum is olive silty clay loam grading with depth to olive gray silty clay loam. In a few areas the subsoil is grayer.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is low, and the available subsoil potassium is very low. Unless limed, the surface layer is medium acid. Surface runoff is medium. Organic matter content in the surface layer is moderate.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent excessive soil loss. Most areas are well suited to contouring and terracing. With terraces this soil can be planted to row crops more often than with most other conservation practices. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIe.

281C2—Otley silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on rather long, slightly convex side slopes in gently rolling areas. Individual areas are long and irregular in shape and usually are several hundred feet wide. They are 10 to 50 acres in size.

Typically, the surface layer is dark brown silty clay loam mottled with brown and is about 3 to 7 inches thick. The subsoil extends to a depth of about 44 inches. It is dark brown and brown silty clay loam in the upper part, brown silty clay loam in the middle part, and olive gray silty clay loam in the lower part. The substratum is olive silty clay loam to olive gray silty clay loam. In a few small areas the soil is strongly sloping and is mottled olive gray and strong brown in the middle and lower parts of the subsoil.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is low, and the available subsoil potassium is very low. Unless limed, the surface layer is medium acid. Surface runoff is medium. Organic matter content in the surface layer is moderate.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If this soil is cultivated, there is further hazard of erosion. Minimum tillage helps prevent excessive soil loss. Most areas are well suited to contouring and terracing. With terraces this soil can be planted to row crops more often than with most other conservation practices. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain soil tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep 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 in on slightly convex side slopes in dissected areas. Individual areas are long and irregular in shape and usually several hundred feet wide. They are 10 to 80 acres or more in size.

Typically, the surface layer is dark brown silty clay loam mottled with brown and is 3 to 7 inches thick. The subsoil extends to a depth of about 42 inches. It is dark brown and brown silty clay loam in the upper part, brown silty clay loam in the middle part, and olive gray silty clay loam in the lower part. The substratum is olive silty clay loam grading with depth to olive gray silty clay loam. In a few areas the middle and lower parts of the subsoil are mottled olive gray and strong brown.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is low, and the available subsoil potassium is very low. Unless limed, the surface layer is medium acid. Surface runoff is

medium or rapid. Organic matter content in the surface layer is moderate.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of further erosion. Minimum tillage helps prevent excessive soil loss. Most areas are suited to contouring and terracing. When terraced this soil can be planted to row crops more often than with most other conservation practices. Returning crop residue to the soil or regularly adding other organic material improves fertility and soil tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIIe.

313D2—Gosport silt loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on convex side slopes on uplands. Individual areas are long, narrow, and irregular in shape and are 10 to 20 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsoil extends to a depth of about 26 inches. It is grayish brown silty clay loam in the upper part, mottled light brownish gray and brownish yellow silty clay in the middle part, and gleyed greenish gray and light greenish gray silty clay in the lower part. The substratum is coarsely mottled light yellowish brown and light gray clay shale.

This soil has very slow permeability and moderate available water capacity. The available subsoil phosphorus is very low, and the available subsoil potassium is low. Unless limed, the surface layer is strongly acid. Surface runoff is medium or rapid. Organic matter content in the surface layer is moderately low.

This soil is poorly suited to corn, soybeans, and small grains. It is better suited to grasses and legumes for hay and pasture. This soil is suited to trees. A few areas are reverting to timber.

If this soil is cultivated, there is a hazard of further erosion. Minimum tillage helps prevent excessive soil loss. In some places contouring is beneficial. Terracing is not satisfactory because of slope, the very firm subsoil, and very slow permeability. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain soil tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increased runoff, and poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed by site preparation, prescribed burning, or cutting and spraying.

This soil is in capability subclass IVe.

313E2—Gosport silt loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, moderately well drained soil is on convex side slopes on uplands. Individual areas are long, narrow, and irregular in shape. They range from 10 to 25 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsoil extends to a depth of about 26 inches. It is grayish brown silty clay loam in the upper part, mottled light brownish gray and brownish yellow silty clay in the middle part, and gleyed greenish gray and light greenish gray silty clay in the lower part. The substratum is coarsely mottled light yellowish brown and light gray clay shale.

This soil has very slow permeability and moderate available water capacity. The available subsoil phosphorus is very low, and the available subsoil potassium is low. Unless limed, the surface layer is strongly acid. Surface runoff is rapid. Organic matter content in the surface layer is low.

Because this soil is too steep for use of ordinary farm machinery, it is poorly suited to corn, soybeans, and small grains. It is suited to grasses and legumes for hay and pasture. This soil is suited to trees. A few small areas remain in native hardwoods.

If this soil is cultivated, there is a severe hazard of erosion. Minimum tillage helps prevent excessive soil loss. This soil is too steep for construction of terraces, and it also has an unfavorable very firm subsoil, is very slowly permeable, and is difficult to renovate when the subsoil is exposed. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain soil tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed by site preparation, prescribed burning, or spraying and cutting.

This soil is in capability subclass VIIe.

313F2—Gosport silt loam, 18 to 25 percent slopes, moderately eroded. This steep, moderately well drained soil is on convex side slopes on uplands. Individual areas are long, narrow, and irregular in shape and range from 15 to 40 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsoil extends to a depth of about 26 inches. It is grayish brown silty clay loam in the upper part, mottled light brownish gray and brownish yellow silty clay in the middle part, and gleyed greenish gray and light greenish gray silty clay in the lower part. The substratum is coarsely mottled light yellowish brown and light gray clay shale.

This soil has very slow permeability and moderate available water capacity. The available subsoil phosphorus is very low, and the available subsoil potassium is low. Unless limed, the surface layer is strongly acid. Surface runoff is rapid or very rapid. Organic matter content of the surface layer is low.

This soil is poorly suited to corn, soybeans, small grains, and grasses and legumes for hay. It is suited to permanent pasture. This soil is also suited to trees. A few areas remain in native hardwoods (fig. 13).

If this soil is cultivated, there is a severe hazard of erosion. Returning crop residue to the soil or regularly adding other organic material improves soil tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition. Renovation of pasture is difficult because of the steep slopes.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed by site preparation, prescribed burning, and spraying and cutting.

This soil is in capability subclass VIIe.

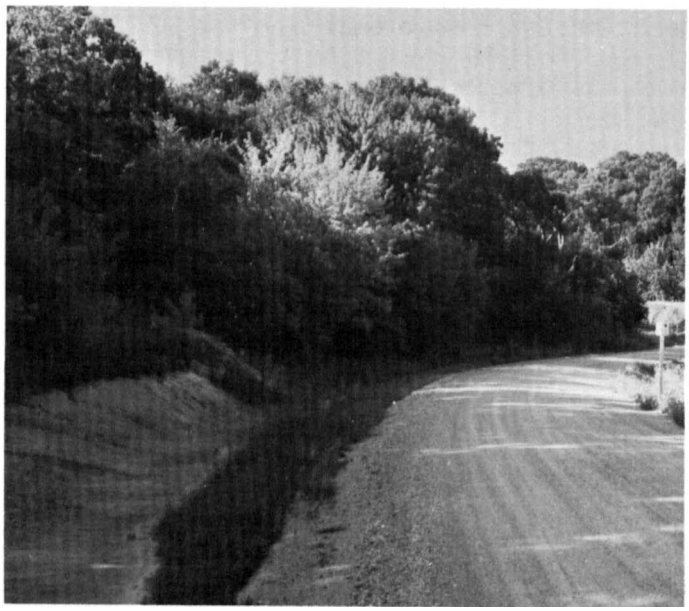


Figure 13.—Native hardwoods on Gosport silt loam, 18 to 25 percent slopes, moderately eroded.

315—Alluvial land-Landes complex, 0 to 2 percent slopes. This complex is on wide bottom lands of rivers and creeks, in most places adjacent to former and present stream channels. The complex consists of nearly level Alluvial land and Landes loam. These soils are subject to flooding. Areas of this complex are somewhat regular in shape and range from 10 to 50 acres in size. The areas are long and narrow and are parallel to the rivers or stream channels in many places. The complex is about 40 percent Alluvial land, 40 percent Landes soil, and 20 percent Nodaway, Ackmore, and Colo silt loam overwash soils.

Alluvial land is coarsely stratified silt and sand with some lenses of silty clay loam and clay loam. Organic matter content is variable.

Typically, the surface layer of the Landes soil is very dark grayish brown loam and fine sandy loam about 18 inches thick. The substratum is stratified light brownish gray fine sand and very dark grayish brown loam.

The Landes soil has rapid permeability and low available water capacity. The available subsoil phosphorus and potassium are very low. The Landes soil is neutral or mildly alkaline. Runoff is slow. Organic matter content is variable.

The soils in this complex are suited to row crops if they are protected from flooding. The surface layer is friable and easy to till in most places. However, the sand content makes these soils susceptible to blowing. In some areas, these soils are droughty during the growing season and crop production is limited. Many areas of this complex have a meandering stream or river channel. In many years crops are damaged by overflow or deposition. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

If these soils are used for pasture or hay, overgrazing the pasture or grazing when the soil is too wet causes surface compaction and results in poor tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This complex is in capability subclass IIs.

362—Haig silt loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on broad upland divides. Individual areas are long and irregular in shape and range from a few acres to several hundred acres in size.

Typically, the surface layer is black silt loam and silty clay loam about 14 inches thick. The subsoil extends to a depth of about 50 inches. It is very dark gray silty clay loam in the upper part, olive gray silty clay and silty clay loam in the middle part, and light olive gray and olive gray silty clay loam in the lower part. The substratum is light olive gray silty clay loam.

This soil has slow to very slow permeability and high available water capacity. This soil has a seasonal high water table, especially in spring. The available subsoil phosphorus and potassium are low. Unless limed, the surface layer is medium acid. Runoff is slow. Organic matter content in the surface layer is high.

This soil is well suited to corn, soybeans, and small grains. It is also well suited to grasses and legumes for hay and pasture.

Surface drainage may make field operations more timely in years of above normal rainfall. These slowly to very slowly permeable soils are difficult to drain with subsurface systems. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

If this soil is used for pasture, overgrazing the pasture or grazing when the soil is too wet causes surface compaction and poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIw.

364B—Grundy silty clay loam, 2 to 5 percent slopes. This gently sloping, somewhat poorly drained soil is on broad upland ridgetops. Individual areas are long and irregular in shape and range from 5 to 10 acres in size.

Typically, the surface layer is very dark brown silty clay loam about 13 inches thick. The subsoil extends to a depth of 60 inches or more. It is dark grayish brown silty clay loam in the upper part, grayish brown silty clay and silty clay loam in the middle part, and light brownish gray silty clay loam in the lower part.

This soil has slow permeability and high available water capacity. The available subsoil phosphorus is very low, and the available subsoil potassium is low to medium. Unless limed, the surface layer is slightly acid. Surface runoff is medium. Organic matter content in the surface layer is moderate.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIe.

368—Macksburg silty clay loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on broad upland divides. Individual areas are long and one-eighth to one-fourth mile wide. They range from 10 acres to several hundred acres in size.

Typically, the surface layer is black and very dark grayish brown silty clay loam about 24 inches thick. The subsoil extends to a depth of about 55 inches. It is dark grayish brown silty clay loam in the upper part, grayish brown and light brownish gray silty clay loam in the middle part, and olive gray silty clay loam in the lower part. The substratum is light olive gray silty clay loam. In a few small areas the soil is poorly drained and has a grayer subsoil. There are a few small depressions.

This soil has moderate permeability and high available water capacity. This soil has a seasonal high water table, especially in spring. The available subsoil phosphorus is low, and the available subsoil potassium is medium. Unless limed, the surface layer is medium acid. Surface runoff is slow. Organic matter content of the surface layer is high.

This soil is well suited to corn, soybeans, and small grains. It is also well suited to grasses and legumes for hay and pasture.

Minimum tillage helps prevent wind erosion. Subsurface drainage may make field operations more timely in years of above normal rainfall. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

If this soil is used for pasture, overgrazing the pasture or grazing when the soil is too wet causes surface compaction and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability class I.

368B—Macksburg silty clay loam, 2 to 5 percent slopes. This gently sloping, somewhat poorly drained soil is where enough water collects to form waterways at the edge of wide, nearly level upland divides. These areas have numerous small drainageways. Slopes are more concave than convex. Individual areas are one-half mile or more long and less than one-eighth mile wide and irregular in shape because of the numerous drainageways. They range from 5 to 30 acres in size.

Typically, the surface layer is black and very dark grayish brown silty clay loam about 24 inches thick. The subsoil extends to a depth of about 55 inches. It is dark grayish brown silty clay loam in the upper part, grayish brown and light brownish gray silty clay loam in the middle part, and olive gray silty clay loam in the lower

part. The substratum is light olive gray silty clay loam. In some small areas along waterways the soil is more poorly drained and has a thicker surface layer and a grayer subsoil. In some areas the soil is brown in the upper part of the subsoil and mottled strong brown and light olive gray in the lower part.

This soil has moderate permeability and high available water capacity. This soil has a high water table. The available subsoil phosphorus is low, and the available subsoil potassium is medium. Unless limed, the surface layer is medium acid. Surface runoff is slow or medium. Organic matter content in the surface layer is high.

This soil is well suited to corn, soybeans, and small grains. It is also well suited to grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent soil loss. In most places contouring and terracing are beneficial. In places subsurface systems that drain the head of the waterway improves the timeliness of field operations in wet years. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIe.

369—Winterset silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on upland divides. Individual areas are regular in shape and are 10 acres to several hundred acres in size.

Typically, the surface layer is black and very dark gray silty clay loam about 16 inches thick. The subsoil extends to a depth of about 48 inches. It is very dark gray silty clay loam in the upper part, dark gray and olive gray silty clay in the middle part, and olive gray silty clay loam in the lower part. The substratum is light olive gray silty clay loam.

This soil has moderately slow permeability and high available water capacity. This soil has a seasonal high water table, especially in spring. The available subsoil phosphorus is low to medium, and the available subsoil potassium is medium. Unless limed, the surface layer is medium acid. Surface runoff is slow. Organic matter content in the surface layer is high.

This soil is well suited to corn, soybeans, and small grains. It is also well suited to grasses and legumes for hay and pasture.

Subsurface drainage may make field operations more timely in years of above normal rainfall. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

If this soil is used for pasture, overgrazing the pasture or grazing when the soil is too wet causes surface compaction and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIw.

370B—Sharpsburg silty clay loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on upland ridgetops and shoulders of divides. Individual areas are generally long and irregular in shape. They are 5 acres to several hundred acres in size.

Typically, the surface layer is very dark gray, dark brown, and very dark grayish brown silty clay loam about 17 inches thick. The subsoil extends to a depth of about 56 inches. It is brown silty clay loam in the upper part and brown and yellowish brown silty clay loam in the lower part. The substratum is light brownish gray silt loam. In a few areas the subsoil is grayer.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is low, and the available subsoil potassium is medium. Unless limed, the surface layer is medium acid. Surface runoff is slow or medium. Organic matter content in the surface layer is moderate.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent excessive soil loss. Most areas are suited to contouring and terracing. With terraces this soil can be planted to row crops more often than with most other conservation practices. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pasture, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIe.

370C—Sharpsburg silty clay loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on the upper part of long, slightly convex side slopes and on narrow divides. Individual areas are long and irregular in shape and usually several hundred feet wide. They range from 10 to 30 acres in size.

Typically, the surface layer is very dark gray, dark brown, and very dark grayish brown silty clay loam about 17 inches thick. The subsoil extends to a depth of about 56 inches. It is brown silty clay loam in the upper part and brown and yellowish brown silty clay loam in the lower part. The substratum is light brownish gray silt loam. In some areas in coves at the heads of drain-

ageways, the soil is poorly drained. In some areas the lower part of the subsoil is mottled olive gray and strong brown.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is low, and the available subsoil potassium is medium. Unless limed, the surface layer is medium acid. Surface runoff is medium. Organic matter content in the surface layer is moderate.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent excessive soil loss. Most areas are suited to contouring and terracing. With terraces this soil can be planted to row crops more often than with more other conservation practices. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increased runoff, and poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIIe.

370C2—Sharpsburg silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on long, slightly convex side slopes. Individual areas are long and irregular in shape and usually several hundred feet wide. They range from 10 to 50 acres in size.

Typically, the surface layer is dark brown silty clay loam mottled with brown and is about 3 to 7 inches thick. The subsoil extends to a depth of about 48 inches. It is brown silty clay loam in the upper part and brown and yellowish brown silty clay loam in the lower part. The substratum is light brownish gray silt loam. In a few areas the lower part of the subsoil is mottled olive gray and strong brown.

This soil has moderate permeability and high available

Figure 14.—Terraces help prevent erosion on Sharpsburg silty clay loam, 5 to 9 percent slopes, moderately eroded.

water capacity. The available subsoil phosphorus is low, and the available subsoil potassium is medium. Unless limed, the surface layer is medium acid. Surface runoff is medium. Organic matter content in the surface layer is moderate.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If this soil is cultivated, there is a further hazard of erosion. Minimum tillage and winter cover crops help prevent excessive soil loss. Most areas are suited to contouring and terracing. With terraces this soil can be planted to row crops more often than with most other conservation practices (fig. 14). Returning crop residue to the soil or regularly adding other organic material helps maintain good soil tilth and improves fertility.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the soil or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIIe.

370D2—Sharpsburg silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on slightly convex upland side slopes. Individual areas are parallel to drainageways. Areas are long and somewhat irregular in shape. Areas are usually several hundred feet wide and are typically 10 to 60 acres in size.

Typically, the surface layer is dark brown silty clay loam mottled with brown and is about 3 to 7 inches thick. The subsoil extends to a depth of about 48 inches. It is brown silty clay loam in the upper part and brown and yellowish brown silty clay loam in the lower part. The substratum is light brownish gray silt loam. In a few areas the lower part of the subsoil is mottled olive gray and strong brown.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is low, and the available subsoil potassium is medium. Unless limed, the surface layer is medium acid. Surface runoff is medium or rapid. Organic matter content in the surface layer is moderate.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of further erosion. Minimum tillage helps prevent excessive soil loss. Most areas are well suited to contouring and terracing. With terraces this soil can be planted to row crops more often than with other conservation practices. Returning crop residue to the soil or regularly adding other organic material improves fertility and soil tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIIe.

373E—Tallula-Downs silt loams, 12 to 20 percent slopes. These strongly sloping to steep, well drained soils are on sides of valleys on the south side of the Skunk River where the river valley has an extended east-west and northwest-southeast orientation. Areas of these soils are long, narrow, and irregular in shape and range in size from 15 to 30 acres. The Tallula soil makes up about 50 percent of this complex, and the Downs soil makes up about 40 percent.

Typically, the surface layer of the Tallula soil is very dark grayish brown silt loam about 13 inches thick. The subsoil extends to a depth of about 23 inches. It is a brown silt loam in the upper part and brown and yellowish silt loam in the lower part. The substratum is calcareous mottled light yellowish brown and grayish brown silt loam.

The Tallula soil has moderate permeability and high available water capacity. The available subsoil phosphorus is low, and the available subsoil potassium is very low. The surface layer and subsoil are neutral or mildly alkaline. The substratum is calcareous. Organic matter content in the surface layer is moderate. Runoff is rapid.

Typically, the surface layer of the Downs soil is very dark gray silt loam about 8 inches thick. The subsoil extends to a depth of 60 inches. It is brown silty clay loam in the upper part, yellowish brown silty clay loam in the middle part, and mottled yellowish brown and grayish brown silt loam and silty clay loam in the lower part.

The Downs soil has moderate permeability and high available water capacity. The available subsoil phosphorus is medium, and the available subsoil potassium is very low. Unless limed, the surface layer is slightly acid. Surface runoff is rapid. Organic matter content in the surface layer is moderate.

These soils are moderately well suited to row crops in rotation with small grains and grasses and legumes for hay and pasture. The soils are better suited to continuous hay and pasture. These soils are suited to trees. A few small areas remain in native hardwoods.

If these soils are cultivated, there is a severe hazard of erosion. Minimum tillage helps prevent soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

The use of these soils for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing

when the soils are too wet causes surface compaction, increased runoff, and poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed by site preparation, prescribed burning, or cutting and spraying.

This complex 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 fans. Individual areas are long, narrow, and irregular in shape and range from 5 to 10 acres in size.

Typically, the surface layer is very dark grayish brown silty clay loam about 25 inches thick. The subsoil extends to a depth of 60 inches or more. It is dark grayish brown silty clay loam in the upper part, grayish brown silty clay loam in the middle part, and olive gray silty clay loam in the lower part. In some areas the soil has a browner subsoil or a grayer subsoil.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is low, and the available subsoil potassium is very low. Unless limed, the surface layer is slightly acid. Surface runoff is slow or medium. Organic matter content in the surface layer is high.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent soil loss. Diversion terraces protect this soil from runoff from higher lying soils. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increased runoff, and poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIe.

430—Ackmore silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on flood plains of major streams. This soil is subject to flooding. Individual areas are regular in shape and range from 10 to 80 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The upper part of the substratum is very dark gray and grayish brown silt loam, and the lower part is black silty clay loam.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is low, and the available subsoil potassium is very low. The surface layer is slightly acid to mildly alkaline. Surface runoff is low. Organic matter content in the surface layer is moderate.

This soil is suited to corn, soybeans, and grasses and legumes for hay and pasture if flooding is not too frequent.

Spring tillage and planting are sometimes delayed by flooding. Artificial drainage lowers the water table and improves the timeliness of field operations. Areas that are frequently flooded or are dissected by old stream channels but that are not adequately drained are generally used for pasture or hay. Diversion terraces help protect this soil from flooding. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

If this soil is used for pasture or hay, overgrazing or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIw.

453—Tuskeego silt loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on slightly concave first and second bottoms. Individual areas are regular and somewhat oval in shape and range from 10 to 15 acres in size.

Typically, the surface layer is very dark gray and very dark grayish brown silt loam about 9 inches thick. The subsurface layer is light brownish gray or pale brown silt loam about 11 inches thick. The subsoil extends to a depth of about 48 inches. It is grayish brown silty clay loam in the upper part, dark gray and grayish brown silty clay loam in the middle part, and gray silty clay loam in the lower part. The substratum is light brownish gray silty clay loam.

This soil has very slow permeability and high available water capacity. The available subsoil phosphorus and potassium are very low. Unless limed, the surface layer is medium acid. Surface runoff is slow. Organic matter content in the surface layer is moderate.

This soil is suited to corn, soybeans, and grasses and legumes for hay and pasture if the soil is drained and if flooding is not too frequent.

Artificial drainage lowers the water table and improves the timeliness of field operations. Artificial drainage can be accomplished in many places by surface systems. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

If this soil is used for pasture or hay, overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer

tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIIw.

478G—Gosport-Rock outcrop complex, 25 to 60 percent slopes. This complex is on steep and very steep sides of river valleys and in smaller areas on highly dissected landscapes along the major tributaries of the rivers. Areas of this complex are long, narrow, and somewhat regular in shape. They are 50 to 100 acres in size. The large areas along rivers are mostly steep Gosport soils with sandstone outcrops on the very steep side slopes. In many places the slopes are less than 40 percent. The complex is about 40 percent Gosport soils, 40 percent Rock outcrop, and about 20 percent soils that formed in loess or glacial till. Some Lindley soils are included with the Gosport soils, and in some areas there is a thin mantle of loess over the glacial material.

Typically, the surface layer of the Gosport soil is dark grayish brown silt loam about 6 inches thick. The subsoil extends to a depth of about 26 inches. It is grayish brown silty clay loam in the upper part, mottled light brownish gray and brownish yellow silty clay in the middle part, and gleyed greenish gray and light greenish gray silty clay in the lower part. The substratum is coarsely mottled light yellowish brown and light gray clay shale.

The Gosport soil has very slow permeability and moderate available water capacity. The available subsoil phosphorus is very low, and the available subsoil potassium is low. Unless limed, the surface layer is strongly acid. Surface runoff is very rapid. Organic matter content in the surface layer is variable.

In some places in the eastern and southeastern parts of the county the Rock outcrop is limestone escarpments. In other places the Rock outcrop is mostly weakly cemented siltstone or sandstone. Surface runoff is very rapid.

The Gosport soil is not suited to crops or pasture and hay. The very steep areas of Gosport soil are of marginal value for trees. The combinations of very steep slopes and low natural fertility is unfavorable for most plants. The steep included soils that formed in loess and glacial till have some value for woodland.

Around Red Rock Lake, picnic areas, camping areas, and homesites are being developed above areas of this complex. This complex is used for hiking, nature trails, and other recreational purposes. Intensive use of the areas of this complex creates a hazard of erosion.

This complex is in capability subclass VIIe.

485—Spillville loam, 0 to 2 percent slopes. This nearly level, moderately well drained and somewhat poorly drained soil is on slightly elevated areas on wide bottom lands. This soil is subject to flooding. Individual areas are long and wide and are generally parallel to the stream channel. The areas are regular in shape and range from 15 to 50 acres in size.

Typically, the surface layer is black, very dark brown, very dark gray, and very dark grayish brown loam and silt loam about 46 inches thick. The substratum is dark grayish brown loam. In some small areas the surface layer is only 18 to 24 inches thick and there is sandy loam at a depth of less than 40 inches.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is low, and the available subsoil potassium is very low. Unless limed, the surface layer is slightly acid. Organic matter content in the surface layer is high.

This soil is suited to corn, soybeans, and grasses and legumes for hay and pasture.

Spring plowing and planting are delayed in some years by flooding. Diversion terraces help protect the soil from flooding. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

If this soil is used for pasture or hay, overgrazing the pasture or grazing when the soil is too wet causes surface compaction and poorer tilth. Stocking at proper rates, rotating pastures, grazing at appropriate times, and restricting use during wet periods help keep pastures and soil in good condition.

This soil is in capability class I.

570B—Nira silty clay loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is in coves at the head of drainageways adjacent to broad upland divides. Individual areas are irregular in shape and range from 10 to 30 acres in size.

Typically, the surface layer is very dark gray and black silty clay loam about 12 inches thick. The subsoil extends to a depth of about 36 inches. It is dark brown silty clay loam in the upper part; dark brown, strong brown, and grayish brown silty clay loam in the middle part; and grayish brown and light brownish gray silty clay loam in the lower part. The substratum is olive gray and light olive gray silt loam or silty clay loam.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is low, and the available subsoil potassium is very low. Unless limed, the surface layer is slightly acid. Surface runoff is slow or medium. Organic matter content in the surface layer is moderate.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent excessive soil loss. Most areas are well suited to contouring and terracing. With terraces this soil can be planted to row crops more often than with most other conservation practices. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIe.

570C2—Nira silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on sides of broad upland divides. Individual areas are irregular in shape and range from 10 to 75 acres in size.

Typically, the surface layer is very dark grayish brown and dark brown silty clay loam about 3 to 6 inches thick. The subsoil extends to a depth of about 35 inches. It is dark brown silty clay loam in the upper part, dark brown, strong brown, and grayish brown silty clay loam in the middle part, and grayish brown and light brownish gray silty clay loam in the lower part. The substratum is olive gray and light olive gray silt loam or silty clay loam.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is low, and the available subsoil potassium is very low. Unless limed, the surface layer is slightly acid. Surface runoff is medium. Organic matter content in the surface layer is moderate.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If this soil is cultivated, there is a further hazard of erosion. Minimum tillage helps prevent excessive soil loss. Most areas are suited to contouring and terracing. With terraces this soil can be planted to row crops more often than with most other conservation practices. Returning crop residue to the soil or regularly adding other organic material improves fertility and soil tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIIe.

822D2—Lamoni silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, somewhat poorly drained soil is on the lower part of side slopes along drainageways that extend into the uplands. Individual areas are long and irregular in shape and range from a few acres to 20 acres in size.

Typically, the surface layer is very dark grayish brown silty clay loam about 6 inches thick. The subsoil extends to a depth of about 47 inches. It is dark grayish brown and grayish brown silty clay loam in the upper part; grayish brown, light olive brown, olive, and dark grayish brown clay loam in the middle part; and mottled light olive gray, yellowish brown, and strong brown clay loam in the lower part. The substratum is yellowish brown loam.

This soil has slow or very slow permeability and high available water capacity. The available subsoil phosphorus is low, and the available subsoil potassium is low to medium. Unless limed, the surface layer is medium acid. Surface runoff is medium or rapid. Organic matter content in the surface layer is moderate.

This soil is moderately well suited to corn, soybeans, and small grains. It is better suited to grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of further erosion. Minimum tillage helps prevent excessive soil loss. In some places contouring is beneficial. Terracing is only moderately satisfactory because of slope, the very firm subsoil, and the slow to very slow permeability. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain soil tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IVe.

831B—Pershing silt loam, benches, 2 to 5 percent slopes. This gently sloping, somewhat poorly drained or moderately well drained soil is on loess-covered benches in the valleys of the major streams. They are rather narrow but extend several hundred feet parallel to the valley side. Individual areas range from 10 to 20 acres in size.

Typically, the surface layer is very dark gray and very dark grayish brown silt loam about 6 inches thick. The subsurface layer is dark grayish brown silt loam about 3 inches thick. The subsoil extends to a depth of 60 inches. It is dark grayish brown and grayish brown silty clay loam in the upper part, grayish brown silty clay loam and silty clay in the middle part, and light brownish gray silty clay loam in the lower part.

This soil has slow permeability and high available water capacity. The available subsoil phosphorus is high, and the available subsoil potassium is very low. Unless limed, the surface layer is slightly acid. Surface runoff is medium. Organic matter content in the surface layer is moderate.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent soil loss. In some places diversion terraces are needed upslope to protect this soil from runoff from higher lying soils. Returning crop resi-

due to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pasture, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIe.

870B—Sharpsburg silty clay loam, benches, 2 to 5 percent slopes. This nearly level, moderately well drained soil is on high stream benches along the major streams. Individual areas are regular in shape and range from 10 to 30 acres in size.

Typically, the surface layer is very dark gray, dark brown, and very dark grayish brown silty clay loam about 17 inches thick. The subsoil extends to a depth of about 56 inches. It is brown silty clay loam in the upper part and brown and yellowish brown silty clay loam in the lower part. The substratum is light brownish gray silt loam.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is low, and the available subsoil potassium is medium. Unless limed, the surface layer is medium acid. Surface runoff is slow or medium. Organic matter content in the surface layer is moderate.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent excessive soil loss. Some areas are suited to contouring. Returning crop residue to the soil or regularly adding other organic material improves fertility and soil tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIe.

870C—Sharpsburg silty clay loam, benches, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on convex sides of benches along major streams. Individual areas are regular in shape and range from 10 to 40 acres in size.

Typically, the surface layer is very dark gray, dark brown, and very dark grayish brown silty clay loam about 17 inches thick. The subsoil extends to a depth of about 48 inches. It is brown silty clay loam in the upper part and brown and yellowish brown silty clay loam in the lower part. The substratum is light brownish gray silt loam.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is low, and the available subsoil potassium is medium. Unless limed, the surface layer is medium acid. The surface runoff is medium. Organic matter content in the surface layer is moderate.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent excessive soil loss. Many areas of this soil are suited to contouring. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIIe.

876B—Ladoga silt loam, benches, 2 to 6 percent slopes. This gently sloping, moderately well drained soil is on loess-covered benches in the valleys of the major streams. Areas are generally longer in the direction parallel to the valley side. Individual areas are rather regular in shape and range from 10 to 20 acres in size.

Typically, the surface layer is very dark gray to dark gray silt loam about 9 inches thick. The subsurface layer is dark grayish brown silt loam about 3 inches thick. The subsoil extends to a depth of 60 inches or more. It is brown silty clay loam in the upper part, yellowish brown silty clay loam in the middle part, and mottled light brownish gray and yellowish brown silty clay loam in the lower part. Sandy loam alluvium is at a depth of 7 to 10 feet. In some areas short, steeper slopes are between these soils and the flood plains.

This soil has moderate permeability and high available water capacity. The available subsoil phosphorus is medium, and the available subsoil potassium is very low. Unless limed, the surface layer is generally slightly acid or medium acid. Surface runoff is slow or medium. Organic matter content in the surface layer is moderate.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

If this soil is cultivated, there is a hazard of erosion. Minimum tillage helps prevent soil loss. Some areas are suited to contouring. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increased runoff, and poorer tilth. Stocking at proper rates, rotating pasture, deferring grazing at appropriate

times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability subclass IIe.

993D2—Gara-Armstrong complex, 9 to 14 percent slopes, moderately eroded. These strongly sloping soils are on tops and convex sides of low ridges. Individual areas are long and irregularly shaped bands 5 to 50 acres in size. The Gara soil makes up about 50 percent of this complex, and the Armstrong soil makes up about 40 percent.

Typically, the surface layer of the moderately eroded Gara soil is very dark grayish brown loam about 6 inches thick. The subsoil extends to a depth of about 40 inches. It is brown loam in the upper part, dark yellowish brown or yellowish brown loam and clay loam in the middle part, and coarsely mottled light brownish gray and yellowish brown loam in the lower part. The substratum is coarsely mottled light brownish gray and yellowish brown clay loam.

The Gara soil has moderately slow permeability and high available water capacity. The available subsoil phosphorus and potassium are very low. Unless limed, the surface layer is medium acid. Surface runoff is medium or rapid. Organic matter content in the surface layer is moderate.

Typically, the Armstrong soil has a surface layer of very dark grayish brown silty clay loam about 5 inches thick. The subsurface layer is dark brown silty clay loam about 2 inches thick. The subsoil extends to a depth of about 42 inches. It is dark yellowish brown clay in the upper part; dark brown, strong brown, and yellowish brown clay in the middle part; and yellowish brown and dark grayish brown clay loam in the lower part. The substratum is yellowish brown and brown clay loam.

The Armstrong soil has slow permeability and high available water capacity. The available subsoil phosphorus and potassium are very low. Unless limed, the surface layer is medium acid. Surface runoff is medium or rapid. Organic matter content in the surface layer is moderate.

Included with this complex in mapping are small areas of Lindley soils and of soils that are similar to Armstrong soils but that have a thinner dark colored surface layer and a more distinct subsurface layer. Also included are small areas on footslopes of soils that have loamy surface and subsurface layers that together are 15 to 18 inches thick.

This complex is suited to occasional crops of corn, soybeans, and small grains. It is better suited to grasses and legumes for hay and pasture.

If these soils are cultivated, there is a hazard of further erosion. Minimum tillage and grassed waterways help prevent excessive soil loss. In some places contouring also helps. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain soil tilth.

The use of these soils for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soils are wet causes surface compaction, increases runoff, and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This complex is in capability subclass IVe.

993E2—Gara-Armstrong complex, 14 to 18 percent slopes, moderately eroded. These moderately steep soils are in bands on the convex lower part of valley sides. Individual areas are irregular in shape and range from 10 to 80 acres in size. The Gara soil makes up about 60 percent of this complex, and the Armstrong soil makes up about 30 percent.

Typically, the surface layer of the Gara soil is very dark grayish brown loam about 6 inches thick. The subsoil extends to a depth of about 40 inches. It is brown loam in the upper part, dark yellowish brown or yellowish brown loam and clay loam in the middle part, and coarsely mottled light brownish gray and yellowish brown loam in the lower part. The substratum is coarsely mottled light brownish gray and yellowish brown clay loam. In many places the surface layer is clay loam.

This Gara soil has moderately slow permeability and high available water capacity. The available subsoil phosphorus and potassium are very low. Unless limed, the surface layer is medium acid. Surface runoff is rapid. Organic matter content in the surface layer is moderate.

Typically, the surface layer of the Armstrong soil is very dark grayish brown silty clay loam about 5 inches thick. The subsurface layer is dark brown silty clay loam about 2 inches thick. The subsoil extends to a depth of about 42 inches. It is dark yellowish brown clay in the upper part; dark brown, strong brown, and yellowish brown clay in the middle part; and yellowish brown and dark grayish brown clay loam in the lower part. The substratum is yellowish brown and brown clay loam.

The Armstrong soil has slow permeability and high available water capacity. The available subsoil phosphorus and potassium are very low. Unless limed, the surface layer is medium acid. Surface runoff is rapid. Organic matter content of the surface layer is moderate.

Included with this complex in mapping are small areas of Lindley soils and of soils that are similar to Armstrong soils but that have a thinner dark colored surface layer and a more distinct subsurface layer. Also included are areas on concave foot slopes of soils that have loamy surface and subsurface layers that together are 15 to 18 inches thick.

Because these soils are too steep for use of ordinary farm machinery, they are not suited to corn, soybeans, or small grains. They are suited to grasses and legumes for hay and pasture.

If these soils are cultivated, there is a severe hazard of erosion. These soils are also too steep for the con-

struction of terraces and have an unfavorable firm subsoil and are difficult to revegetate when the subsoil is exposed.

The use of these soils for pasture or hay is effective in controlling erosion. Overgrazing the pasture or grazing when the soil is too wet causes surface compaction, increased runoff, and poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition. Returning crop residue to the soil or regularly adding other organic material improve fertility and maintain soil tilth.

This complex is in capability subclass VIe.

1075—Givin silt loam, benches, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on loess-covered benches in the valleys of the major streams. Individual areas are parallel to the valley side. Areas are regular in shape and range from 5 to 15 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown silt loam about 5 inches thick. The subsoil extends to a depth of 60 inches or more. It is dark grayish brown and brown silty clay loam in the upper part, grayish brown silty clay loam in the middle part, and mottled yellowish brown and light olive gray silty clay loam in the lower part. Sandy loam alluvium is at a depth of 7 to 10 feet. In some areas the soil has a grayer subsoil, and in other areas the soil has a thinner surface layer over a more distinct, gray subsurface layer.

This soil has moderately slow permeability and high available water capacity. This soil has a seasonal high water table, especially in spring. The available subsoil phosphorus is medium, and the available subsoil potassium is very low. Unless limed, the surface layer is strongly acid. Surface runoff is slow. Organic matter content in the surface layer is moderate.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

Subsurface drainage may make field operations more timely in years of above normal rainfall. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

If this soil is used for pasture, overgrazing the pasture or grazing when the soil is too wet causes surface compaction and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability class I.

1220—Nodaway silt loam, channeled, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on flood plains in areas that have a system of former stream channels. Channels several feet wide are at intervals of 100 to 200 feet. This soil is subject to flooding. Areas are rather long and narrow and range from 30 to 80 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The substratum has layers of brown, very dark grayish brown, and pale brown silt loam with strata of fine sandy loam in the lower part. In some small areas Zook and Colo soils are in channels. In a few areas the surface layer is sandy.

This soil has moderate permeability and very high available water capacity. The available subsoil phosphorus is medium, and the available subsoil potassium is medium. The surface layer is slightly acid to neutral. Runoff is slow. Organic matter content in the surface layer is moderate to moderately low.

Because of the hazard of flooding and the presence of old stream channels that pond water for long periods, this soil is not suited to corn, soybeans, small grains, or grasses for hay. This soil is better suited to woodland and wildlife habitat. Most areas are in trees and other woody plants.

In many places the old stream channels and oxbows exclude farm machinery from the areas. If cultivated crops are to be grown, land leveling, flood control, and surface drainage are needed.

If this soil is used for pasture, overgrazing the pasture or grazing when the soil is too wet causes surface compaction and poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed by site preparation, prescribed burning, or spraying or cutting.

This soil is in capability subclass Vw.

1315—Alluvial land-Landes complex, channeled, 0 to 2 percent slopes. This complex is on wide bottom lands of rivers and creeks adjacent to former and present stream channels. Although the soils are nearly level in most places, there are many deep meander scars, small oxbow lakes, and low natural levees of coarse sand. These soils are subject to flooding. Areas of this complex are elongated and are parallel to the stream channels. Individual areas are 20 to 100 acres in size. The complex consists of small areas of nearly level Landes soil adjacent to large areas of Alluvial land. Alluvial land makes up about 75 percent of the complex, and the Landes soil makes up 25 percent.

Alluvial land is coarsely stratified silt and sand with some lenses of silty clay loam and clay loam.

Typically, the surface layer of the Landes soil is very dark grayish brown loam and fine sandy loam about 18 inches thick. The substratum is stratified light brownish gray fine sand and very dark grayish brown loam.

The Landes soil has rapid permeability and low available water capacity. The available phosphorus and potas-

sium are very low. These soils are neutral throughout. Runoff is slow. Organic matter content in the surface layer is variable because of the nature of the alluvium.

Because of the hazard of flooding and the presence of old stream channels that pond water for long periods, these soils are not suited to corn, soybeans, small grains, and grasses for hay. In many places the old stream channels and oxbows exclude farm machinery from the areas. These soils are better suited to wildlife habitat and woodland. Some trees are harvested for lumber.

If these soils are used for pasture, overgrazing the pasture or grazing when the soil is too wet causes surface compaction and results in poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

Tree seeds germinate well and cuttings and seedlings survive and grow well if competing vegetation is controlled or removed by site preparation, prescribed burning, or spraying and cutting.

This complex is in capability subclass Vw.

1316—Alluvial land, wet, 0 to 2 percent slopes. This map unit is adjacent to former and present stream channels that are immediately upstream from the permanent pool of Red Rock Lake. Although Alluvial land is nearly level in most places, it has many meander scars, small oxbow lakes, and shallow ponds. Because of the high water table and ponded condition, these soils cannot be mapped in detail. This unit is one continuous irregularly shaped area about 1,800 acres in size.

Alluvial land is coarsely stratified silt and sand with some lenses of silty clay loam and clay loam. A few small areas of Nodaway silt loam in channels are included.

Alluvial land is used for wildlife habitat. There are constant fluctuations in the water level of a few inches to a foot or more. The first vegetation that appears following the initial filling of the permanent pool and the submerging of the area is willows. Vegetation may change from time to time depending upon the water level of the lake.

Alluvial land is in capability subclass VIIw.

1368—Macksburg silty clay loam, benches, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on loess-covered benches adjacent to major streams. Individual areas are irregular in shape and range from 10 to 20 acres in size.

Typically, the surface layer is black and very dark grayish brown silty clay loam about 24 inches thick. The subsoil extends to a depth of about 55 inches. It is dark grayish brown silty clay loam in the upper part, grayish brown silty clay loam and light brownish gray silty clay loam in the middle part, and olive gray silty clay loam in the lower part. The substratum is light olive gray silty clay loam.

This soil has moderate permeability and high available water capacity. This soil has a seasonal high water table, especially in spring. The available subsoil phosphorus is low, and the available subsoil potassium is medium. Unless limed, the surface layer is medium acid. Surface runoff is slow. Organic matter content in the surface layer is high.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

Subsurface drainage may make field operations more timely in years of above normal rainfall. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps maintain good tilth.

If this soil is used for pasture, overgrazing the pasture or grazing when the soil is too wet causes surface compaction and poorer tilth. Stocking at proper rates, rotating pastures, deferring grazing at appropriate times, and restricting use during wet periods help keep pasture and soil in good condition.

This soil is in capability class I.

5020G—Strip mine spoils, 25 to 80 percent slopes. Areas of strip mine spoils remain where coal was mined. The strip mines are pits 40 feet or more deep and the mounds of spoil are 30 feet or more high. Slopes are 70 to 80 percent. The pits contain water a few feet to many feet deep. They range from a fraction of an acre to several acres in size. Areas are irregular in shape and 10 to 1,000 acres in size.

Some small ponds are surrounded by mine spoils. Water in these ponds has pH of 4 to 7 and fish cannot survive. Some ponds that have less sloping shores have a growth of cattails and reeds, but others are too acid to support vegetation.

The most abundant spoil material is carbonaceous shale. The lignite is very dark gray to gray and the shale is grayish brown to yellowish brown in most places. On slopes of 30 to 80 percent, this material has pH of 3 to 5 at the surface and supports no vegetation. In some places on slopes of 60 percent the shale is neutral in reaction and supports annual weeds.

In a few places the material is glacial till mixed with shale. These materials are olive gray to yellowish brown and have pH of 5 to 7. At the crests of piles of this material slopes are 10 to 30 percent, and some bluegrass and cottonwood saplings grow.

In a few places the spoil is loamy shale or siltstone. At the less sloping crests of these spoil piles the material has a dark yellowish brown surface layer and supports povertygrass, even though pH is only 3.5 to 4. A planting of conifers in yellowish brown siltstone spoil with pH of 6 to 7 and 30 to 60 percent slopes has provided a canopy and litter that appear to have stopped most erosion (fig. 15). The annual growth rate of the trees is very slow.

Strip mine spoils is in capability subclass VIIIs.

5040—Cut and fill land. In areas of Cut and fill land, the soils have been disturbed and mixed during construction.

Figure 15.—Conifers provide canopy and litter that reduce erosion on Strip mine spoils.

Land leveling and grading for urban development is responsible for about a quarter of the cut and fill in Marion County. These areas are generally nearly level or gently sloping and are near Knoxville, Pella, and Pleasantville. The material remaining in these areas is mostly loess, which is easily revegetated.

About a quarter of the Cut and fill land was formed during the construction of highways adjacent to Red Rock Lake. Much of this area is at the upstream end of the permanent pool where material was removed and used as fill for Highway 14 and the perimeter road. The material remaining in the borrow areas is mostly shale or loess over shale. Plant cover is especially difficult to establish and maintain here because these areas are subject to flooding.

Construction of the dam created another quarter of the Cut and fill land in the county. The topsoil from the borrow areas was stockpiled, and most of the loess and thin glacial till was removed for fill. The material remaining in the borrow areas was mostly sand or weakly consolidated sandstone on the north side of the river and largely shale on the south side. Six inches of topsoil was spread over the borrow areas, and all areas were seeded to grasses. Since some of the strongly sloping or moderately steep areas are highly erodible, a plant cover is difficult to maintain.

The remaining cut and fill is mostly in small areas along highways and railroads. These areas are moderately steep to very steep. The quality of the plant cover depends largely on the kind of material involved. Where Gosport soils are adjacent, the cuts have a poor plant cover. Where Lindley or Gara soils are adjacent, revegetation has been more successful.

Cut and fill land is in capability subclass VIIe.

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, flood-

ing, 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 "Soil maps for detailed planning." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

More than 275,000 acres in the survey area was used for crops and pasture in 1973 (*15*). Of this, 100,000 acres was used for permanent pasture; 134,000 acres for row crops, mainly corn and soybeans; 11,000 acres for close-grown crops, mainly oats; and 31,000 acres for rotation hay and pasture.

The potential of the soils in Marion County for increased production of food is good. About 5,000 acres of potentially good cropland is currently used as woodland and about 20,000 acres as pasture. In addition to the reserve productive capacity represented by this land, food production could also be increased considerably by extending the latest crop production technology to all cropland in the county. This soil survey can greatly facilitate the application of such technology.

The acreage in crops and pasture has gradually been decreasing as more and more land is used for urban development. It was estimated that in 1973 there was about 6,000 acres of urban and built up land in the county; this figure has been growing at the rate of about 100 acres per year. 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 for broad land use planning."

Soil erosion is the major soil problem on about two-thirds of the cropland and pasture in Marion County. Where 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 with 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 on clayey spots because the original friable surface layer has been eroded away. Such spots are common in areas of moderately eroded soils.

Erosion control practices provide a protective surface cover, reduce runoff, and increase infiltration. A cropping system that keeps a plant cover on the soil for extended periods can hold soil erosion losses to amounts that will 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 sloping land 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 plant cover are required to control erosion unless minimum tillage is practiced. Minimizing tillage and leaving crop residue on the surface help to increase infiltration and reduce runoff and erosion. These practices can be used on most soils in the survey area, but are more difficult to use successfully on eroded soils and on soils that have a clayey surface layer. No-tillage for corn, which is common on an increasing acreage, is effective in reducing erosion on sloping land and can be used on 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. The other soils are less suitable for terracing and diversions because of irregular slopes, excessive wetness in the terrace channels, or a clayey subsoil that would be exposed in terrace channels.

Contouring and contour stripcropping are erosion control practices in the survey area. They are most suitable for soils with smooth, uniform slopes.

Wind erosion is a hazard on sandy soils. Wind erosion 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 plant cover, surface mulch, or a rough surface through proper tillage minimizes soil blowing on these soils.

Information for the design of erosion control practices for each kind of soil is available from local offices of the Soil Conservation Service.

Soil drainage is the major management need on about one-third of the acreage used for crops and pasture in the survey area. Some soils are naturally so wet that the production of crops common to the area is generally not possible. These poorly drained and very poorly drained soils make up about 12,000 acres of the survey area. Unless artificially drained, the poorly drained soils and part 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 tend to dry slowly after rains. Small areas of wetter soils along drainageways and in swales are commonly included in areas of the 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 areas.

The design of both surface and subsurface drainage systems varies with the kind of soil. A combination of surface drainage and tile drainage is needed in most areas of the poorly drained and very poorly drained soils used intensively for row crops. Drains have to be more closely spaced in soils with slow permeability than in the more permeable soils. Tile drainage is very slow in soils that have a very clayey subsoil. Finding adequate outlets for tile drainage systems is difficult in many bottom lands. Information on drainage design for each kind of soil is available from local offices of the Soil Conservation Service.

Soil fertility is naturally low in many soils of the uplands in the survey area. Most soils are naturally acid. If they have never been limed they require applications of ground limestone to raise the pH sufficiently for good growth of alfalfa and other crops that grow only on nearly neutral soils. 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 with good tilth are granular and porous.

Most of the soils used for crops in the survey area have a silt loam or a silty clay loam surface layer 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 and higher in clay than the uneroded soil. Generally the structure of such soils is weak, and intense rainfall causes a crust to form on the surface. When dry, the crust is hard and nearly impervious to water. Once the crust forms, it reduces infiltration and increases runoff. Regular additions of crop residue, manure, and other organic material can help to improve soil structure and reduce crust formation.

Plowing in fall is generally a good practice on the county's dark-colored soils that have a heavy silty clay loam or silty clay surface layer because structure improves with freezing and thawing. If these soils are wet when plowed, they tend to be very cloddy when dry, and a good seedbed is difficult to prepare. About two-thirds of the cropland is sloping soils that are subject to damaging erosion if they are plowed in fall.

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.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

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 if they are used for field crops, the risk of damage if they are used, 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 Marion County soils are generally grouped at two levels: capability class and subclass. 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 make them generally unsuitable for cultivation.

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

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

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

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

The capability classification of each map unit is given in the section "Soil maps for detailed planning."

Woodland management and productivity

Table 6 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 6, *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 *plant competition* indicate the degree to which undesirable plants are expected to invade where there are openings in the tree canopy. The invading plants compete with native plants or planted seedlings. A rating of *slight* indicates little or no competition from other plants; *moderate* indicates that plant competition is expected to hinder the development of a fully stocked stand of desirable trees; *severe* indicates that plant competition is expected to prevent the establishment of a desirable stand unless the site is intensively prepared, weeded, or otherwise managed to control undesirable plants.

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

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

Windbreaks and environmental plantings

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, 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 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 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

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation (fig. 16). 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 8, 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 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

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

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

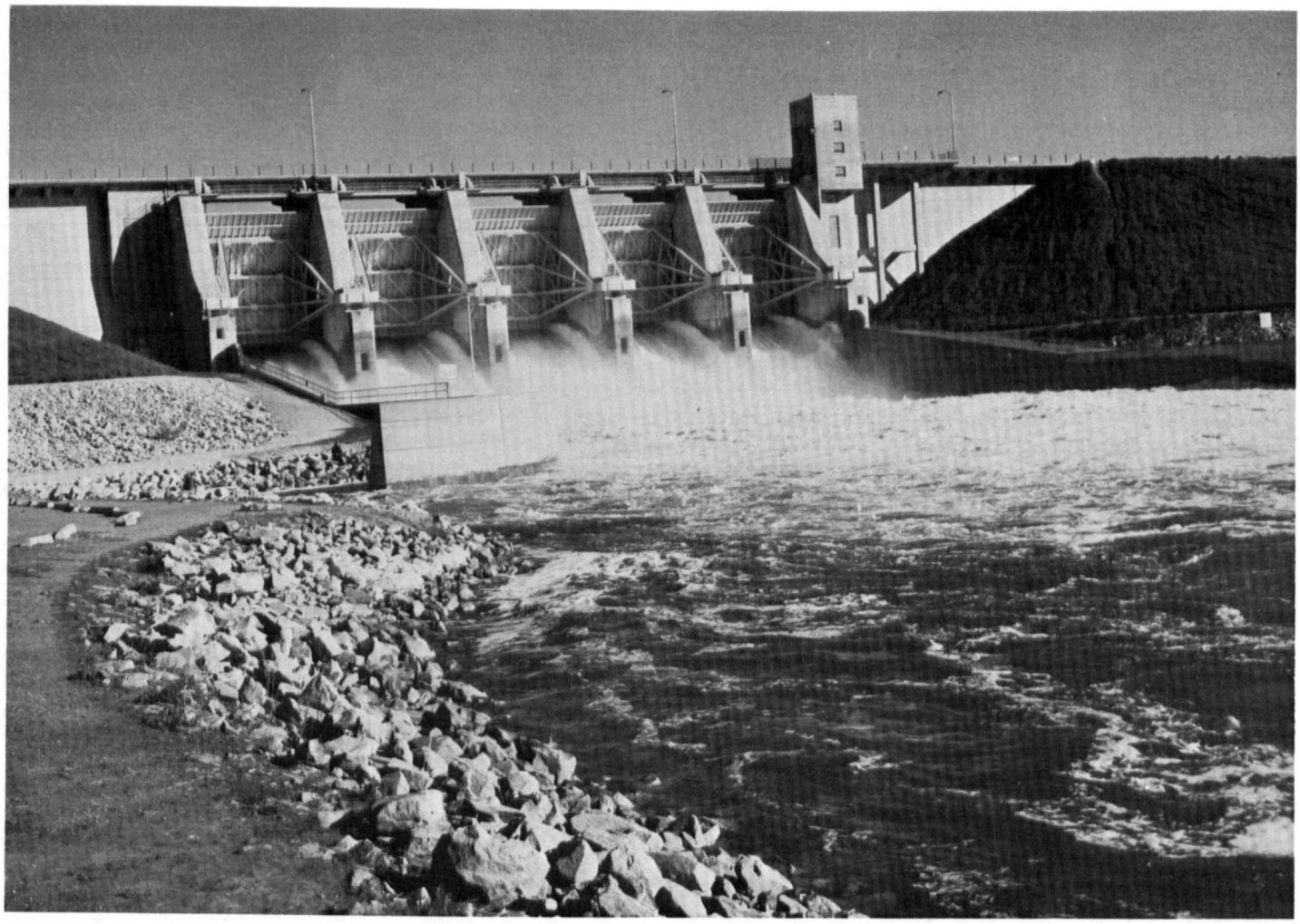


Figure 16.—Access to water is important for recreation potential.

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.

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 9, 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 inten-

sity 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, sweetgum, apple, hawthorn, dogwood, hickory, 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, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, saltgrass, cordgrass, rushes, sedges, and reeds.

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

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

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

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

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

Engineering

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

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Be-

cause 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 10 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.

Sanitary facilities

Table 11 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 11 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 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

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

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

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

The ratings in table 11 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 tranches, 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 12 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 suitable or unsuitable 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 properties and classifications 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 (fig. 17). In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

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

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

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

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

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

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

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

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

Water management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed ponds.

This table also gives for each soil the restrictive fea-

Figure 17.—Alluvial soils on the Des Moines River bottom land contain large quantities of sand and gravel.

tures that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment (fig. 18). Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

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

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

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

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is affected by extreme acidity or

Figure 18.—Farm ponds are an important source of water for livestock.

by toxic substances on the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

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

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of 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 properties and classifications

Table 14 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 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.

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 15 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 ex-

pressed 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 16 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 is not considered flooding.

Table 16 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 are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 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 16.

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 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.

Soil series and 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 (*14*). 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 "Soil maps for detailed planning."

Ackmore series

The Ackmore series consists of somewhat poorly drained, moderately permeable soils. These soils are on flood plains near the main stream channel. Ackmore soils formed in recent medium textured alluvium over silty clay loam alluvium. The native vegetation was mixed prairie grasses and forest. Slope ranges from 0 to 2 percent.

Typical pedon of Ackmore silt loam, 0 to 2 percent slopes, on bottom land in a cultivated field, 81 feet east and 501 feet north of the southwest corner of the NW1/4SW1/4 sec. 7, T. 77 N., R. 18 W.:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam; weak fine and very fine granular structure; friable; neutral; abrupt smooth boundary.

C1—8 to 15 inches; stratified very dark gray (10YR 3/1) and grayish brown (10YR 5/2 and 2.5Y 5/2) silt loam, grayish brown (10YR 5/2) dry; moderate medium platy structure; friable; neutral; clear smooth boundary.

C2—15 to 27 inches; stratified very dark gray (10YR 3/1) and grayish brown (2.5Y 5/2) silt loam, grayish brown (10YR 5/2) dry; moderate medium and thick platy structure; friable; many fine distinct brown (7.5YR 4/4) iron oxides; neutral; clear smooth boundary.

C3—27 to 32 inches; stratified grayish brown (2.5Y 5/2) and black (10YR 2/1) heavy silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

IIA11b—32 to 41 inches; black (N 2/0) light silty clay loam; moderate fine granular structure parting to moderate very fine subangular blocky; friable; neutral; gradual smooth boundary.

IIA12b—41 to 50 inches; black (N 2/0) light silty clay loam; moderate very fine subangular blocky structure; firm; neutral; gradual smooth boundary.

IIB1b—50 to 60 inches; black (5Y 2/1) silty clay loam; common fine faint olive (5Y 5/3) mottles; weak fine prismatic structure parting to moderate fine subangular blocky; firm; neutral.

The Ap horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2). The Ap horizon is 6 to 8 inches thick and is neutral or mildly alkaline.

The C horizon is 10 to 24 inches thick and is neutral or mildly alkaline.

The IIA horizon is black (10YR 2/1 or N 2/0) light or medium silty clay loam. It is 18 to 40 inches thick and is neutral or mildly alkaline.

The IIB horizon is very dark gray (N 3/0) or black (5Y 2/1) medium or heavy silty clay loam. It is neutral or mildly alkaline.

Adair series

The Adair series consists of moderately well drained and somewhat poorly drained, slowly permeable soils. These soils are on convex side slopes adjacent to broad upland divides. Adair soils formed in weathered moderately fine textured glacial till near the contact between loess and till. Native vegetation was prairie grasses. Slope ranges from 9 to 14 percent.

These soils are outside the defined range of the Adair series because the layer having mollic properties is not thick enough to be a mollic epipedon.

Typical pedon of Adair silty clay loam in an area of Shelby-Adair complex, 9 to 14 percent slopes, moderately eroded, in a cultivated field, 70 feet east and 210 feet north of the southwest corner of the NW1/4SW1/4 sec. 10, T. 77 N., R. 19 W.:

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) light silty clay loam, grayish brown (10YR 5/2) dry; few fine distinct, brown (7.5YR 4/4) mottles; very dark brown (10YR 2/2) coatings on peds; cloddy parting to weak fine granular structure; friable; neutral; abrupt smooth boundary.

B1—6 to 10 inches; dark brown (10YR 4/3) light silty clay loam; few fine distinct reddish brown (5YR 4/4) mottles; dark brown (7.5YR 4/2) coatings on peds; weak medium subangular blocky structure parting to moderate very fine subangular blocky; friable; neutral; abrupt smooth boundary.

IIB21t—10 to 15 inches; dark brown (7.5YR 4/4) light clay loam; common fine distinct reddish brown (5YR 5/4) mottles; moderate medium subangular blocky structure; firm; patchy thin clay films; coarse sand grains; slightly acid; gradual smooth boundary.

IIB22t—15 to 27 inches; mottled dark brown (7.5YR 4/4) and red (2.5YR 4/6) heavy clay loam; weak medium prismatic structure parting to moderate medium subangular blocky; very firm; thick discontinuous clay films; coarse sand grains; many pebbles; few very dark grayish brown (10YR 3/2) organic stains; medium acid; diffuse boundary.

IIB23t—27 to 33 inches; mottled strong brown (7.5YR 5/6) and brown (10YR 5/3) clay loam; few medium distinct red (2.5YR 4/6) mottles; moderate medium subangular blocky structure; very firm; few roots above a depth of 30 inches; patchy thick clay films; coarse sand grains; some pebbles; medium acid; gradual smooth boundary.

IIB31t—33 to 42 inches; mottled strong brown (7.5YR 5/8) and light brownish gray (10YR 6/2) light clay loam; few fine distinct, yellowish red (5YR 5/6) mottles; moderate coarse subangular blocky structure; very firm; patchy thin clay films; a few pebbles; medium acid; diffuse boundary.

IIB32—42 to 60 inches; brown (10YR 5/3) light clay loam; common coarse distinct light brownish gray (10YR 6/2) mottles; weak coarse subangular blocky structure; firm; few fine dark oxides; a few pebbles; neutral.

The solum ranges from 40 to 65 inches in thickness.

The Ap horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2). It ranges from silt loam to light clay loam. The Ap horizon is 6 to 8 inches thick and is slightly acid or neutral.

The IIB22t horizon is dark brown (7.5YR 4/4) or dark yellowish brown (10YR 4/4). Mottles range from grayish brown (2.5Y 5/2) to red (2.5Y 4/6). Texture is heavy clay loam or light clay. The IIB22t horizon is 8 to 12 inches thick.

The IIB32 horizon ranges from brown (10YR 5/3) to yellowish brown (10YR 5/6). Mottles range from olive gray (5Y 5/2) to light brownish gray (10YR 6/2). The texture is light or medium clay loam. The IIB32 horizon is 6 to 18 inches thick.

Arispe series

The Arispe series consists of moderately well drained and somewhat poorly drained, moderately slowly permeable soils. These soils are on short convex side slopes on uplands. Arispe soils formed in moderately fine textured loess underlain by a gray clayey paleosol at a depth of 5 feet or more. The native vegetation was prairie grasses. Slope ranges from 5 to 9 percent.

Typical pedon of Arispe silty clay loam in an area of Clearfield-Arispe silty clay loams, 5 to 9 percent slopes, on an upland divide in a hayfield, 67 feet north and 380 feet west of the southeast corner of the SW1/4NW1/4 sec. 25, T. 74 N., R. 21 W.:

Ap—0 to 7 inches; very dark brown (10YR 2/2) silty clay loam; black (10YR 2/1) coatings on peds, dark gray (10YR 4/1) dry; weak medium granular structure; friable; neutral; gradual smooth boundary.

B1—7 to 11 inches; very dark grayish brown (10YR 3/2) and 15 percent dark grayish brown (2.5Y 4/2) heavy silty clay loam; few fine distinct yellowish brown (10YR 5/4) mottles; faces of peds very dark brown (10YR 2/2); moderate very fine subangular blocky structure; friable; neutral; gradual smooth boundary.

B21tg—11 to 16 inches; dark grayish brown (2.5Y 4/2) heavy silty clay loam; common medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; faces of peds very dark grayish brown (2.5Y 3/2); moderate fine subangular blocky structure; firm; thick discontinuous clay films; few soft black oxides; slightly acid; gradual smooth boundary.

B22tg—16 to 23 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium distinct yellowish brown (10YR 5/6) and few fine distinct brown (7.5YR 4/4) mottles; moderate medium subangular blocky structure; firm; thin discontinuous clay films; few soft black oxides; slightly acid; diffuse boundary.

B23tg—23 to 34 inches; light brownish gray (2.5Y 6/2) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; thin discontinuous clay films; few soft black oxides; slightly acid; diffuse boundary.

B3tg—34 to 45 inches; light olive gray (5Y 6/2) light silty clay loam; common coarse prominent reddish brown (5YR 4/4) mottles; weak medium prismatic structure; firm; thin discontinuous clay films; few hard concretions; slightly acid; diffuse boundary.

C—45 to 60 inches; light olive gray (5Y 6/2) light silty clay loam; common coarse distinct strong brown (7.5YR 5/8) mottles; massive; friable; few roots above a depth of 48 inches; neutral.

The solum ranges from 36 to 60 inches in thickness.

The Ap horizon is black (10YR 2/1) or very dark brown (10YR 2/2) medium or heavy silty clay loam. The Ap horizon is 7 inches thick and is medium acid, slightly acid, or neutral.

The B1 horizon ranges from very dark gray (10YR 3/1) to dark grayish brown (2.5Y 4/2). Texture is medium or heavy silty clay loam. The B1 horizon is 4 to 8 inches thick and ranges from medium acid to neutral.

The B22tg horizon ranges from dark grayish brown (10YR 4/2) to grayish brown (2.5Y 5/2). Texture is medium or heavy silty clay loam. The B22tg horizon is 5 to 10 inches thick and is medium acid or slightly acid.

The C horizon ranges from gray (5Y 5/1) to light olive gray (5Y 6/2). Texture is light or medium silty clay loam.

In the Arispe part of map unit 230C2, the mollic material is not thick enough to be a mollic epipedon.

Armstrong series

The Armstrong series consists of moderately well drained and somewhat poorly drained slowly permeable soils. These soils are on convex side slopes at the loess and glacial till contact on a highly dissected upland. Armstrong soils formed in weathered moderately fine textured glacial till near the contact between loess and the till. The native vegetation was mixed prairie grasses and trees. Slope ranges from 9 to 18 percent.

Typical pedon of Armstrong silty clay loam in an area of Gara-Armstrong complex, 9 to 14 percent slopes, moderately eroded, in a pasture, 460 feet south and 280 feet east of the northwest corner of the NW1/4NE1/4 sec. 27, T. 74 N., R. 19 W.:

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

A&B—5 to 7 inches; dark brown (10YR 3/3) heavy silty clay loam, brown (10YR 5/3) dry; weak coarse platy structure parting to moderate fine subangular blocky; friable; few roots; discontinuous gray silt coatings; strongly acid; clear smooth boundary.

B1—7 to 12 inches; dark yellowish brown (10YR 3/4 and 4/4) clay; very dark grayish brown (10YR 3/2) coatings on peds; moderate fine subangular blocky structure; friable; sand coatings on peds; medium acid; gradual smooth boundary.

IIB21t—12 to 18 inches; dark brown (7.5YR 4/3) clay; few medium distinct dark brown (7.5YR 4/2) and many medium distinct yellowish red (5YR 4/6) mottles; moderate fine subangular blocky structure; firm; few discontinuous clay films; few small pebbles; strongly acid; gradual smooth boundary.

IIB22t—18 to 28 inches; mottled dark brown (7.5YR 4/4) and strong brown (7.5YR 5/6) clay; few medium distinct dark grayish brown (10YR 4/2) mottles; moderate fine subangular blocky structure; very firm; thin discontinuous clay films; common small pebbles; medium acid; gradual smooth boundary.

IIB23t—28 to 35 inches; mottled yellowish brown (10YR 5/6) and dark brown (7.5YR 4/3) clay; many medium distinct dark brown (7.5YR 4/2) mottles; moderate medium subangular blocky structure; very firm; thin discontinuous clay films; few dark oxides; strongly acid; gradual smooth boundary.

IIB3t—35 to 42 inches; mottled yellowish brown (10YR 5/6) and dark grayish brown (10YR 4/2) clay loam; few fine distinct yellowish red (5YR 4/8) mottles; moderate fine subangular blocky structure; firm; few discontinuous thin clay films; common dark oxides; coarse sand grains and many small pebbles; strongly acid; gradual smooth boundary.

C—42 to 60 inches; mottled yellowish brown (10YR 5/8) and brown (10YR 5/3) clay loam; few medium distinct gray (10YR 6/1) mottles; weak medium subangular blocky structure; firm; large dark stains; medium acid.

The solum ranges from about 42 to 80 inches in thickness.

The Ap horizon ranges from silt loam to clay loam. It is 5 to 8 inches thick and is medium acid or slightly acid.

The IIB22t horizon ranges from brown (7.5YR 4/4) and strong brown (7.5YR 5/6) to yellowish brown (10YR 5/4). Mottles range from red (2.5YR 4/6) to dark grayish brown (10YR 4/2). Texture is heavy silty clay loam, light silty clay, or clay. The IIB22t horizon is 4 to 10 inches thick and ranges from very strongly acid to medium acid.

The IIB3t horizon is 7 to 20 inches thick and is medium acid or strongly acid.

Bauer series

The Bauer series consists of well drained to moderately well drained, very slowly permeable soils. These soils are on convex side slopes on uplands. Bauer soils formed in silty sediment and the underlying shale. The native vegetation was prairie grasses. Slope ranges from 9 to 18 percent.

Typical pedon of Bauer silt loam, 9 to 14 percent slopes, in pasture, 100 feet north and 210 feet east of the southwest corner of the SE1/4SW1/4 sec. 1, T. 75 N., R. 21 W.:

A1—0 to 6 inches; black (10YR 2/1) heavy silt loam, very dark grayish brown (10YR 3/2) dry; moderate very fine subangular blocky structure; friable; neutral; clear smooth boundary.

A3—6 to 9 inches; very dark grayish brown (2.5Y 3/2) light silty clay loam, very dark grayish brown (10YR 3/2) dry; faces of peds black (10YR 2/1); moderate very fine and fine subangular blocky structure; friable; neutral; clear smooth boundary.

B1—9 to 12 inches; olive brown (2.5Y 4/4) heavy silty clay loam, grayish brown (2.5Y 5/2) dry; faces of peds very dark gray (10YR 3/1); moderate medium subangular blocky structure; firm; common roots; slightly acid; clear smooth boundary.

IIB2g—12 to 17 inches; grayish brown (2.5Y 5/2) and light olive (2.5Y 5/4) silty clay; common fine distinct yellowish brown (10YR 5/6 and 5/8) mottles; faces of some peds very dark grayish brown (2.5Y 3/2) and dark grayish brown (2.5Y 4/2); moderate medium angular blocky structure; very firm; slightly acid; gradual smooth boundary.

IIB3g—17 to 20 inches; olive (5Y 4/3) clay; faces of peds dark grayish brown (2.5Y 4/2); weak coarse angular blocky structure; very firm; slightly acid; diffuse boundary.

IIC1—20 to 43 inches; light olive brown (2.5Y 5/6) and some gray (5Y 5/1) and light olive gray (5Y 6/2) clay shale; few fine prominent reddish brown (2.5YR 4/4) mottles; faces of some peds dark grayish brown (2.5Y 4/2); weak coarse angular blocky structure; very firm; neutral; diffuse boundary.

IIC2—43 to 60 inches; light brownish gray (2.5Y 6/2) to olive yellow (2.5Y 6/6) clay shale; common coarse distinct dusky red (2.5YR 3/2) mottles; weak thick platy structure; very firm; few roots above a depth of 48 inches; neutral.

The solum ranges from 8 to 24 inches in thickness. The A1 horizon is black (10YR 2/1) or very dark brown (10YR 2/2). It is 6 to 12 inches thick and ranges from medium acid to neutral.

The IIB2g horizon ranges from very dark grayish brown (10YR 3/2) to light olive (2.5Y 5/4). Texture is heavy silty clay loam or silty clay. The IIB2g horizon is 4 to 8 inches thick and ranges from strongly acid to slightly acid.

The IIC horizon ranges from light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/4) to olive yellow (2.5Y 6/6). Thin strata of highly contrasting colors are in this horizon.

Belinda series

The Belinda series consists of poorly drained very slowly permeable soils. These soils are on flat upland divides. Belinda soils formed in loess under grass and trees tolerant of wetness. Slope ranges from 0 to 2 percent.

Typical pedon of Belinda silt loam, 0 to 2 percent slopes, on an upland divide, 100 feet south and 800 feet west of the northeast corner of the NW1/4 sec. 35, T. 74 N., R. 18 W.:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak thick platy structure parting to moderate fine granular; friable; neutral; abrupt smooth boundary.

A21—8 to 13 inches; dark gray (10YR 4/1) light silt loam, light brownish gray (10YR 6/2) dry; weak thick platy structure parting to moderate medium granular; friable; neutral; abrupt smooth boundary.

A22—13 to 16 inches; dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) light silty clay loam, light gray (10YR 7/2) dry; weak thick platy structure parting to moderate very fine subangular blocky; friable; medium acid; abrupt smooth boundary.

B21t—16 to 21 inches; dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) light silty clay; few fine prominent strong brown (7.5YR 5/8) mottles; very dark gray (10YR 3/1) coatings on peds; strong fine subangular blocky structure; very firm; thick continuous clay films; medium acid; clear smooth boundary.

B22t—21 to 27 inches; dark grayish brown (2.5Y 4/2) light silty clay; common medium prominent strong brown (7.5YR 5/8) mottles; very dark gray (10YR 3/1) coatings on peds; strong medium subangular blocky structure; very firm; thick discontinuous clay films; medium acid; gradual smooth boundary.

B23t—27 to 36 inches; grayish brown (2.5Y 5/2) light silty clay; common medium distinct strong brown (7.5YR 5/8) and yellowish brown (10YR 5/8) mottles; dark gray (10YR 4/1) coatings on peds; moderate medium subangular blocky structure; firm; thin discontinuous clay films; strongly acid; gradual smooth boundary.

B31t—36 to 43 inches; olive gray (5Y 5/2) heavy silty clay loam; few medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; thick and thin patchy clay films; common black (10YR 2/1) or very dark gray

(10YR 3/1) organic stains on vertical faces; medium acid; gradual smooth boundary.

B32t—43 to 48 inches; light olive gray (5Y 6/2) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; common black (10YR 2/1) to very dark gray (10YR 3/1) organic stains on vertical faces; medium acid; gradual smooth boundary.

B33t—48 to 54 inches; light olive gray (5Y 6/2) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; thin patchy clay films; few black (10YR 2/1) to very dark gray (10YR 3/1) organic stains on vertical faces; slightly acid; gradual smooth boundary.

C—54 to 60 inches; light olive gray (5Y 6/2) silty clay loam; common coarse prominent brown (7.5YR 5/8) mottles; massive; friable; neutral.

The solum ranges from 48 to 60 inches in thickness. The Al or Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). Texture of the Ap horizon is medium or heavy silt loam. The Ap horizon is 6 to 10 inches thick and is neutral or slightly acid.

The A2 horizon ranges from dark gray (10YR 4/1) to light brownish gray (10YR 6/2) in the lower part. Texture ranges from light silt loam to light silty clay loam.

The B22t horizon ranges from dark grayish brown (10YR 4/2) to grayish brown (2.5Y 5/2). Texture is light or medium silty clay. The B22t horizon is 6 to 10 inches thick and is strongly acid or medium acid.

The C horizon ranges from grayish brown (2.5Y 5/2) to light olive gray (5Y 6/2). Texture is light or medium silty clay loam. It is slightly acid or neutral.

Bremer series

The Bremer series consists of poorly drained, moderately slowly permeable soils. These soils are on low second bottoms along major streams. Bremer soils formed in moderately fine textured to fine textured alluvium along the major streams and rivers. Native vegetation was tall grasses and sedges. Slope ranges from 0 to 2 percent.

Typical pedon of Bremer silty clay loam, 0 to 2 percent slopes, on a low bench in a cultivated field, 190 feet east and 500 feet south of the northwest corner of sec. 1, T. 77 N., R. 19 W.:

Ap—0 to 8 inches; black (10YR 2/1) light silty clay loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; medium acid; clear smooth boundary.

A12—8 to 14 inches; black (10YR 2/1) light silty clay loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; slightly acid; gradual smooth boundary.

B1—14 to 18 inches; black (10YR 2/1) silty clay loam, grayish brown (10YR 5/2) dry; moderate very fine subangular blocky structure; friable; neutral; gradual smooth boundary.

B21tg—18 to 24 inches; very dark gray (10YR 3/1) heavy silty clay loam; few fine faint dark brown (10YR 3/3) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few roots above a depth of 22 inches; discontinuous thick clay films; neutral; gradual smooth boundary.

B22tg—24 to 29 inches; very dark gray (10YR 3/1) heavy silty clay loam; few medium distinct yellowish brown (10YR 5/8) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; discontinuous thick clay films; neutral; gradual smooth boundary.

B23tg—29 to 34 inches; dark gray (10YR 4/1) heavy silty clay loam; many medium distinct light olive brown (2.5Y 5/6) and yellowish brown (10YR 5/6) mottles; many faces of peds very dark gray (10YR 3/1); weak medium prismatic structure parting to weak medium subangular blocky; firm; very few tubular pores; patchy thick clay films; neutral; gradual smooth boundary.

B3tg—34 to 50 inches; mottled light olive gray (5Y 6/2) and yellowish brown (10YR 5/6) silty clay loam; a few faces of peds dark gray (10YR 4/1) in upper part of the horizon; weak medium prismatic structure; firm; dark gray (10YR 4/1) clay films on prism faces; neutral at a depth of 40 inches; gradual smooth boundary.

Cg—50 to 78 inches; mottled light olive gray (5Y 6/2) and light olive brown (2.5Y 5/6) silty clay loam; massive; firm; some coarse sand grains; neutral.

The solum ranges from 40 to 60 inches in thickness. The A horizon is black (10YR 2/1 and N 2/0) or very dark gray (N 3/0). Texture ranges from heavy silt loam to medium silty clay loam. The A horizon is 14 to 20 inches thick and is medium acid or slightly acid.

The B22tg horizon ranges from very dark gray (N 3/0) to dark gray (10YR 4/1 and 5Y 4/1). Texture is heavy silty clay loam or silty clay. The B22tg horizon is 5 to 12 inches thick and ranges from medium acid to neutral.

The Cg horizon is dark gray (10YR 4/1 and 5Y 4/1) or light olive gray (5Y 6/2). Texture ranges from medium silty clay loam to light silty clay. The C horizon is slightly acid or neutral.

Caleb series

The Caleb series consists of moderately well drained, moderately permeable soils. These soils are on convex sides of high benches along rivers and their large tributaries. Caleb soils formed in old alluvium derived from

glacial till under mixed prairie grasses and trees. Slope ranges from 9 to 14 percent.

Typical pedon of Caleb loam in an area of Caleb-Mystic loams, 9 to 14 percent slopes, moderately eroded, in a pasture, 780 feet west and 520 feet south of the northeast corner of the NE1/4SE1/4 sec. 7, T. 74 N., R. 21 W.:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; firm; common roots; medium acid; abrupt smooth boundary.

B1—7 to 14 inches; brown (10YR 4/3) or dark yellowish brown (10YR 4/4) heavy loam; very dark gray (10YR 3/1) coatings on peds; light brownish gray (10YR 6/2) silt coatings; moderate medium subangular blocky structure; friable; common roots; medium acid; clear smooth boundary.

B21t—14 to 19 inches; yellowish brown (10YR 5/6) light clay loam; few fine distinct dark reddish brown (5YR 2/2 or 3/2) mottles; moderate medium subangular blocky structure; firm; thin discontinuous clay films; thick silt coatings; medium acid; clear smooth boundary.

B22t—19 to 29 inches; yellowish brown (10YR 5/4) clay loam; few fine faint dark reddish brown (5YR 2/2) mottles; light brownish gray (10YR 6/2) silt coatings; strong medium subangular blocky structure; firm; thin discontinuous clay films; some fine sand grains on faces of peds; medium acid; gradual smooth boundary.

B23t—29 to 37 inches; yellowish brown (10YR 5/4) sandy clay loam; common medium distinct grayish brown (10YR 5/2) and few coarse distinct strong brown (7.5YR 5/6) mottles; light brownish gray (10YR 6/2) silt coatings; weak medium prismatic structure parting to moderate medium subangular blocky; firm; thick discontinuous clay films; some fine sand grains on faces of peds; strongly acid; gradual smooth boundary.

B31—37 to 42 inches; strong brown (7.5YR 5/6) and grayish brown (10YR 5/2) sandy loam; moderate medium subangular blocky structure; friable; strongly acid; gradual smooth boundary.

B32—42 to 60 inches; yellowish brown (10YR 5/6) sandy loam; weak coarse subangular blocky structure; friable; medium acid.

The solum is 60 inches or more thick.

The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). Texture ranges from silt loam to clay loam. The Ap horizon is 6 to 9 inches thick and is medium or slightly acid.

An A2 horizon is present in some pedons.

The B2t horizon ranges from brown (10YR 4/3) to yellowish brown (10YR 5/6). It is stratified in many places. The B2t horizon ranges from strongly acid to slightly acid.

Chelsea series

The Chelsea series consists of excessively drained, rapidly permeable soils. These soils are on ridgetops and side slopes along major streams and rivers and extend into the uplands. Chelsea soils formed in wind-deposited sand under trees. Slope ranges from 5 to 18 percent.

Typical pedon of Chelsea loamy fine sand, 5 to 9 percent slopes, in a pasture, 120 feet north and 192 feet east of the southwest corner of the SW1/4SE1/4 sec. 35, T. 76 N., R. 18 W.:

A11—0 to 1 inch; very dark grayish brown (10YR 3/2) loamy fine sand, pale brown (10YR 6/3) dry; single grain; very friable; slightly acid; abrupt smooth boundary.

A12—1 inch to 6 inches; dark brown (10YR 3/3) loamy fine sand, pale brown (10YR 6/3) dry; single grain; very friable; slightly acid; clear smooth boundary.

A21—6 to 15 inches; brown (10YR 4/3) fine sand, pale brown (10YR 6/3) dry; single grain; very friable; strongly acid; gradual smooth boundary.

A22—15 to 22 inches; dark yellowish brown (10YR 4/4) fine sand, very pale brown (10YR 7/3) dry; single grain; very friable; strongly acid; diffuse smooth boundary.

A23—22 to 31 inches; yellowish brown (10YR 5/4) fine sand; single grain; very friable; some clay bridging; medium acid; gradual smooth boundary.

A&B—31 to 60 inches; pale brown (10YR 6/3) and brownish yellow (10YR 6/6) fine sand; single grain; very friable; 3/4-inch to 2-inch band of brown (7.5YR 4/4) sandy loam and iron at depths of 32, 42, 52, and 57 inches; some very dark grayish brown (10YR 3/2) organic coatings at a depth of 52 inches; strongly acid; gradual smooth boundary.

The solum ranges from 4 to many feet in thickness.

The A1 horizon ranges from very dark gray (10YR 3/1) to dark brown (10YR 3/3). Texture is loamy fine sand or fine sand. The A1 horizon is 2 to 6 inches thick.

The A&B horizon ranges from pale brown (10YR 6/3) to brownish yellow (10YR 6/6). Texture is fine sand or loamy fine sand. The A&B horizon has lamellae 1/4 inch to 2 inches thick that have hue of 7.5YR or 10YR and value and chroma of 3 or 4. The A&B horizon ranges from strongly acid to slightly acid.

Clarinda series

The Clarinda series consists of poorly drained, very slowly permeable soils. These soils are on side slopes, generally in coves. Clarinda soils formed in gray gumbotil

under prairie grasses tolerant of wetness. Slope ranges from 5 to 9 percent.

Typical pedon of Clarinda silty clay loam, 5 to 9 percent slopes, on a side slope in a meadow, 460 feet west and 440 feet south of the northeast corner of the NE1/4SW1/4 sec. 30, T. 77 N., R. 18 W.:

Ap—0 to 6 inches; very dark brown (10YR 2/2) light silty clay loam, grayish brown (10YR 5/2) dry; black (10YR 2/1) coatings on peds; weak fine granular structure; friable; slightly acid; clear smooth boundary.

A12—6 to 11 inches; very dark grayish brown (10YR 3/2) light silty clay loam, grayish brown (10YR 5/2) dry; very dark gray (10YR 3/1) coatings on peds; moderate fine and very fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

B1—11 to 16 inches; dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) light silty clay loam, light brownish gray (10YR 6/2) dry; common medium prominent mottles of yellowish red (5YR 4/6); very dark grayish brown (10YR 3/2) coatings on peds; moderate fine subangular blocky structure; firm; roots common above a depth of 13 inches; patchy thin clay films; common fine sand grains; medium acid; clear smooth boundary.

IIB21tg—16 to 23 inches; dark gray (10YR 4/1) silty clay; common fine distinct brown (7.5YR 4/4) mottles; weak medium subangular blocky structure; very firm; thin discontinuous clay films; common medium sand grains; medium acid; gradual smooth boundary.

IIB22tg—23 to 31 inches; gray (10YR 5/1) silty clay; common fine distinct brown (10YR 4/3) mottles; weak medium subangular blocky structure; very firm; few roots above a depth of 28 inches; very few tubular pores; thick continuous clay films; common medium and coarse sand grains; slightly acid; gradual smooth boundary.

IIB23tg—31 to 41 inches; gray (10YR 5/1) light silty clay; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; very firm; thick continuous clay films; common medium and coarse sand grains; slightly acid; gradual smooth boundary.

IIB24tg—41 to 50 inches; light gray (5Y 6/1) light silty clay; few medium distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; very firm; thick continuous clay films; common medium and coarse sand grains; neutral; diffuse boundary.

IIB3tg—50 to 60 inches; light gray (5Y 6/1) heavy silty clay loam; common coarse prominent yellowish red (5YR 4/8) mottles; weak medium prismatic structure; firm; thin discontinuous clay films; common coarse sand grains and small pebbles; neutral.

The solum is commonly more than 5 feet thick.

The A horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2). Texture is heavy silt loam or light silty clay loam. The A horizon is 10 to 16 inches thick and is medium or slightly acid.

The IIB22tg horizon is dark gray (2.5Y or 5Y 4/1) or gray (2.5Y or 5Y 5/1) silty clay or clay. The IIB22tg horizon is 8 to 24 inches thick and is strongly acid or medium acid.

The IIB3tg horizon is gray (5Y 5/1) or light gray (5Y 6/1). Texture ranges from heavy silty clay loam to clay. The IIB3tg horizon is 10 to 20 inches thick and is slightly acid or neutral.

In the soil in map unit 222C2, the mollic material is not thick enough to be a mollic epipedon.

Clearfield series

The Clearfield series consists of poorly drained or somewhat poorly drained, moderately slowly permeable soils. These soils are in coves where forking waterways drain upland divides. Clearfield soils formed in 3 to 5 feet of moderately fine textured loess and the underlying gray glacial material that is high in clay. Native vegetation was prairie grasses tolerant of wetness. Slope ranges from 5 to 9 percent.

Typical pedon of Clearfield silty clay loam, 5 to 9 percent slopes, moderately eroded, on side of a cove in a cultivated field, 300 feet south and 340 feet west of the northeast corner of the NE1/4NW1/4 sec. 35, T. 74 N., R. 20 W.:

Ap—0 to 9 inches; very dark gray (10YR 3/1) light silty clay loam, dark gray (10YR 4/1) dry; few fine distinct light brownish gray (2.5Y 6/2) and few fine distinct brown (7.5YR 4/4) mottles; black (10YR 2/1) coatings on peds; weak fine granular structure; friable; neutral; clear smooth boundary.

B1—9 to 14 inches; grayish brown (2.5Y 5/2) heavy silty clay loam, light brownish gray (2.5Y 6/2) dry; few fine distinct strong brown (7.5YR 5/6) mottles; faces of peds very dark gray (10YR 3/1), dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; firm; neutral; gradual smooth boundary.

B21tg—14 to 20 inches; olive gray (5Y 5/2) heavy silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; faces of peds very dark gray (10YR 3/1); moderate fine subangular blocky structure; firm; thin discontinuous clay films; neutral; gradual smooth boundary.

B22tg—20 to 27 inches; light gray (10YR 6/1) silty clay loam; common medium distinct yellowish brown (10YR 5/8) mottles; some faces of peds very dark gray (10YR 3/1); moderate medium subangular blocky structure; firm; thin discontinuous clay films; neutral; gradual smooth boundary.

B23tg—27 to 36 inches; light gray (5Y 6/1) silty clay loam; common medium distinct strong brown (7.5YR 5/6) and yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; thin discontinuous clay films; band of soft black oxides at a depth of 33 to 36 inches; neutral; diffuse boundary.

B3g—36 to 46 inches; light gray (5Y 6/1) light silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; neutral; gradual smooth boundary.

IIBb—46 to 60 inches; light gray (5Y 6/1) light clay; common medium distinct strong brown (7.5YR 5/6) and yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; fine and medium sand grains; neutral.

The solum is 3 to 5 feet thick.

The Ap horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2). Texture is light or medium silty clay loam. The Ap horizon is 6 to 9 inches thick and is medium acid to neutral.

The B21tg horizon ranges from dark gray (10YR 4/1) to olive gray (5Y 5/2). Texture is medium or heavy silty clay loam. The B21tg horizon is 4 to 8 inches thick and is slightly acid or neutral.

The IIBb horizon ranges from light gray (5Y 6/1) to dark gray (10YR 4/1). Texture is light or medium silty clay.

Clinton series

The Clinton series consists of moderately well drained, moderately permeable soils. These soils are on convex side slopes on uplands. Clinton soils formed in moderately fine textured loess under forest. Slope ranges from 2 to 14 percent.

Typical pedon of Clinton silt loam, 2 to 5 percent slopes, on an upland divide in woodland, 640 feet east and 140 feet north of the southwest corner of the SE1/4SW1/4 sec. 33, T. 77 N., R. 19 W.:

A1—0 to 5 inches; dark grayish brown (10YR 4/2) silt loam, very pale brown (10YR 7/3) dry; weak medium platy structure parting to weak very fine granular; friable; neutral; clear smooth boundary.

A2—5 to 8 inches; brown (10YR 4/3) heavy silt loam, very pale brown (10YR 7/3) dry; faces of peds dark grayish brown (10YR 4/2); weak coarse platy structure parting to very fine subangular blocky; friable; slightly acid; clear smooth boundary.

B1—8 to 14 inches; brown (10YR 4/3) light silty clay loam, very pale brown (10YR 8/3) dry; faces of peds dark grayish brown (10YR 4/2) and brown (10YR 4/3); moderate medium and fine subangular blocky structure; friable; slightly acid; diffuse smooth boundary.

B21t—14 to 24 inches; brown (10YR 5/3) silty clay loam; faces of peds brown (10YR 4/3); moderate medium and fine angular and subangular blocky structure; slightly firm; thin discontinuous clay films; medium acid; gradual smooth boundary.

B22t—24 to 31 inches; brown (10YR 5/3) heavy silty clay loam; faces of peds brown (7.5YR 4/2 to 10YR 4/2); moderate medium angular and subangular blocky structure; firm; discontinuous clay films; medium acid; diffuse boundary.

B23t—31 to 38 inches; yellowish brown (10YR 5/4) silty clay loam; faces of peds brown (7.5YR 4/2); few fine faint light olive gray (5Y 6/2) mottles; moderate medium and coarse angular blocky and subangular blocky structure; slightly firm; thin discontinuous clay films; some small black oxides; medium acid; gradual smooth boundary.

B31t—38 to 46 inches; yellowish brown (10YR 5/4) light silty clay loam; common medium faint light brownish gray (2.5Y 6/2) mottles and few fine distinct strong brown (7.5YR 5/6) mottles; faces of peds brown (10YR 4/3); weak coarse angular blocky and subangular blocky structure; friable; thin discontinuous clay films; few small soft black oxides; medium acid; diffuse boundary.

B32t—46 to 62 inches; light brownish gray (2.5Y 6/2) medium silty clay loam; common medium distinct strong brown (7.5YR 5/6) mottles; weak coarse subangular blocky structure; friable; yellowish brown (10YR 5/4) clay films on vertical faces; few small black oxides; medium acid; diffuse boundary.

C—62 to 84 inches; yellowish brown (10YR 5/4) light silty clay loam; few medium distinct light olive gray (5Y 6/2) mottles; massive; few roots above a depth of 75 inches; common tubular pores above a depth of 80 inches; common small black oxides; medium acid.

The solum ranges from 42 to 84 inches in thickness.

The A1 horizon ranges from very dark gray (10YR 3/1) to dark grayish brown (10YR 4/2). Texture ranges from light to heavy silt loam. Where present, the A1 horizon is as much as 5 inches thick and ranges from strongly acid to neutral.

The A2 horizon ranges from dark grayish brown (10YR 4/2) to brown (10YR 5/3) in color. Texture ranges from light to heavy silt loam. The A2 horizon is 3 to 10 inches thick and ranges from strongly acid to slightly acid.

The B22t horizon is brown (10YR 4/3 or 5/3) heavy silty clay loam or light silty clay. The B22t horizon is 6 to 12 inches thick and ranges from strongly acid to slightly acid.

The C horizon is brown (10YR 5/3) or yellowish brown (10YR 5/4) with grayish brown to olive gray mottles. Texture is light silty clay loam or heavy silt loam.

Colo series

The Colo series consists of poorly drained, moderately permeable soils. These soils are on bottom lands and in drainageways. Colo soils formed in moderately fine textured alluvium under grasses tolerant of excessive wetness. Slope ranges from 0 to 5 percent.

Typical pedon of Colo silty clay loam, 0 to 2 percent slopes, on cultivated bottom land, 500 feet west and 100 feet north of the southeast corner of the NE1/4 sec. 4, T. 77 N., R. 20 W.:

Ap—0 to 7 inches; very dark brown (10YR 2/2) light silty clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; neutral; clear smooth boundary.

A12—7 to 25 inches; black (N 2/0) light silty clay loam; weak very fine subangular blocky structure; friable; neutral; gradual smooth boundary.

A13—25 to 35 inches; black (N 2/0) silty clay loam; weak fine subangular blocky structure; firm; neutral; gradual smooth boundary.

A14—35 to 46 inches; black (N 2/0) silty clay loam; weak very fine subangular blocky structure; firm; few roots above a depth of 40 inches; neutral; gradual smooth boundary.

C1g—46 to 54 inches; very dark gray (10YR 3/1) silty clay loam; weak medium subangular blocky structure; firm; neutral; gradual smooth boundary.

C2g—54 to 60 inches; very dark gray (10YR 3/1) silty clay loam; weak medium subangular blocky structure friable; neutral.

The solum ranges from 36 to 54 inches in thickness. The Ap or A1 horizon ranges from black (N 2/0) to very dark brown (10YR 2/2). Texture of the Ap horizon is heavy silt loam or light silty clay loam. The Ap horizon is 5 to 8 inches thick and ranges from medium acid to neutral.

Downs series

The Downs series consists of well drained, moderately permeable soils. These soils are on ridgetops and side slopes on uplands. Downs soils formed in medium textured loess under mixed prairie grass and trees. Slope ranges from 2 to 14 percent.

Typical pedon of Downs silt loam, 2 to 5 percent slopes, on an upland divide in a cultivated field, 120 feet east and 540 feet south of the northwest corner of the NE1/4NE1/4 sec. 10, T. 77 N., R. 18 W.:

Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam, grayish brown (10YR 5/2) dry; weak thin platy structure parting to weak fine granular; friable; neutral; clear smooth boundary.

A2—8 to 11 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; very dark grayish brown (10YR 3/2) coatings on peds; weak medium platy structure parting to weak fine granular; friable; neutral; clear smooth boundary.

B1—11 to 16 inches; brown (10YR 5/3) light silty clay loam; brown (10YR 4/3) and very dark grayish brown (10YR 3/2) coatings on peds; moderate fine subangular blocky structure; friable; discontinuous light gray silt coatings on peds; slightly acid; gradual smooth boundary.

B21t—16 to 23 inches; brown (10YR 5/3) light silty clay loam; faces of peds brown (10YR 4/3); moderate fine subangular blocky structure; friable; thin discontinuous brown (7.5YR 4/2) clay films; common light gray silt coatings on peds; medium acid; gradual smooth boundary.

B22t—23 to 33 inches; yellowish brown (10YR 5/4) light silty clay loam; brown (10YR 4/3) coatings on peds; weak medium prismatic structure parting to moderate medium subangular blocky; friable; thick and thin discontinuous clay films; medium acid; gradual smooth boundary.

B31t—33 to 40 inches; yellowish brown (10YR 5/4) light silty clay loam; common medium distinct yellowish brown (10YR 5/8) and grayish brown (2.5Y 5/2) mottles; brown (10YR 4/3 and 5/3) coatings on peds; weak medium prismatic structure parting to moderate medium subangular blocky; friable; common roots above a depth of 38 inches; thin discontinuous clay films; medium acid; diffuse boundary.

B32t—40 to 58 inches; mottled yellowish brown (10YR 5/8) and grayish brown (2.5Y 5/2) light silty clay loam; weak coarse prismatic structure parting to weak coarse subangular blocky; friable; thin discontinuous clay films; slightly acid; diffuse boundary.

B33t—58 to 65 inches; mottled yellowish brown (10YR 5/8) and grayish brown (2.5Y 5/2) silt loam; weak coarse prismatic structure; friable; few roots; common tubular pores; dark reddish brown clay flows in root channels; slightly acid.

The A1 or Ap horizon ranges from very dark brown (10YR 2/2) to very dark gray (10YR 3/1). The Ap horizon is 4 to 8 inches thick and ranges from medium acid to neutral.

The A2 horizon ranges from very dark grayish brown (10YR 3/2) to dark grayish brown (10YR 4/2) or brown (10YR 5/3). The A2 horizon is 2 to 4 inches thick and ranges from medium acid to neutral.

The B22t horizon ranges from brown (10YR 4/3) to yellowish brown (10YR 5/6). Texture is light or medium silty clay loam. The B22t horizon is 7 to 11 inches thick and ranges from strongly acid to slightly acid.

Ely series

The Ely series consists of somewhat poorly drained moderately permeable soils. These soils are on slightly concave, low footslopes and fans. Ely soils formed in medium textured local alluvium under prairie grasses. Slope ranges from 2 to 5 percent.

Typical pedon of Ely silty clay loam, 2 to 5 percent slopes, in a cultivated field, 560 feet east and 60 feet north of the southwest corner of the NE1/4NW1/4 sec. 26, T. 77 N., R. 18 W.:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) light silty clay loam, brown (10YR 5/3) dry; weak very fine granular structure; friable; neutral; abrupt smooth boundary.

A12—7 to 12 inches; very dark grayish brown (10YR 3/2) light silty clay loam, grayish brown (10YR 5/2) dry; very dark gray (10YR 3/1) coatings on peds; weak fine granular structure; friable; slightly acid; gradual smooth boundary.

A13—12 to 20 inches; very dark grayish brown (10YR 3/2) light silty clay loam, grayish brown (10YR 5/2) dry; very dark gray (10Y 3/1) coatings on peds; moderate fine granular structure; friable; slightly acid; gradual smooth boundary.

A3—20 to 25 inches; very dark grayish brown (10YR 3/2) light silty clay loam, brown (10YR 5/3) dry; few fine faint yellowish brown (10YR 5/6) and brown (10YR 4/3) mottles; very dark gray (10YR 3/1) coatings on peds; moderate fine granular structure; friable; few fine soft dark oxide accumulations; slightly acid; clear smooth boundary.

B21t—25 to 34 inches; dark grayish brown (10YR 4/2) silty clay loam; faces of peds very dark grayish brown (10YR 3/2) and dark gray (10YR 4/1); common fine distinct dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate fine and medium subangular blocky; firm; few thin discontinuous clay films; medium acid; few soft fine dark oxide accumulations; clear smooth boundary.

B22t—34 to 40 inches; grayish brown (2.5Y 5/2) silty clay loam; many fine and medium distinct brown (7.5YR 4/4) and strong brown (7.5YR 5/8) mottles; common fine gray (5Y 5/1) mottles; moderate fine prismatic structure parting to moderate fine subangular blocky; firm; organic stains along root channels; thin discontinuous grayish brown (10YR 5/2) clay films on prism faces; some soft dark oxide accumulations; slightly acid; gradual smooth boundary.

B3t—40 to 60 inches; olive gray (5Y 5/2) light silty clay loam; many medium and coarse prominent strong brown (7.5YR 5/6) mottles; weak fine and medium prismatic structure; firm; some soft dark oxide accumulations; roots extend to a depth of 52 inches; clay films on root channels; slightly acid.

The solum typically is more than 48 inches thick.

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) silt loam or light silty clay loam. The A horizon is 20 to 26 inches thick and is slightly acid or neutral.

The B21t horizon is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2) light or medium silty clay loam. The B21t horizon is 4 to 9 inches thick and is medium acid or slightly acid.

The B22t horizon ranges from dark grayish brown (10YR 4/2) and brown (10YR 5/3) to grayish brown (2.5Y 5/2). Texture is light or medium silty clay loam. The B22t horizon is 6 to 10 inches thick and medium or slightly acid.

The B3t horizon ranges from grayish brown (10YR 5/2) to olive gray (5Y 5/2). It is slightly acid or neutral.

Fayette series

The Fayette series consists of well drained, moderately permeable soils. These soils are on convex upland ridgetops and side slopes. Fayette soils formed in medium textured loess under forest. Slope ranges from 2 to 25 percent.

Typical pedon of Fayette silt loam, 5 to 9 percent slopes, moderately eroded, on a side slope in a cultivated field, 330 feet east and 60 feet north of the southwest corner of sec. 23, T. 77 N., R. 21 W.:

Ap—0 to 8 inches; brown (10YR 4/3) silt loam, very pale brown (10YR 7/3) dry; faces of peds brown (10YR 4/2); weak medium platy structure parting to weak very fine subangular blocky; friable; neutral; gradual smooth boundary.

B1—8 to 14 inches; dark yellowish brown (10YR 4/4) light silty clay loam, yellow (10YR 7/6) dry; faces of peds brown (10YR 5/3 and 4/4); strong fine subangular blocky and angular blocky structure; friable; continuous gray silt coatings; slightly acid; gradual smooth boundary.

B21t—14 to 23 inches; dark yellowish brown (10YR 4/4) silty clay loam, yellow (10YR 7/6) dry; faces of peds brown (7.5YR 5/2 and 4/4); moderate medium angular blocky and subangular blocky structure; firm; thick discontinuous clay films; discontinuous gray silt coatings; medium acid; gradual smooth boundary.

B22t—23 to 32 inches; dark yellowish brown (10YR 4/4) silty clay loam; few medium distinct light brownish gray (10YR 6/2) mottles; faces of peds brown (7.5YR 5/2 and 4/4); weak medium angular blocky and subangular blocky structure; firm; thin discontinuous clay films; discontinuous gray (10YR 6/2) silt coatings; strongly acid; diffuse boundary.

B3t—32 to 48 inches; yellowish brown (7.5YR 5/4) silty clay loam; many coarse distinct light brownish gray (10YR 6/2) mottles; weak coarse subangular blocky structure; firm; thin discontinuous clay films; medium acid; diffuse boundary.

C—48 to 60 inches; mottled yellowish brown (10YR 5/4) and light brownish gray (10YR 6/2) light silty clay loam; massive; friable; medium acid.

The solum ranges from 36 to 60 inches in thickness.

The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3). It is 4 to 8 inches thick and is slightly acid or neutral.

The B22t horizon is brown (10YR 4/3) or dark yellowish brown (10YR 4/4) light or medium silty clay loam. The B22t horizon is 8 to 10 inches thick and is strongly acid or medium acid.

The C horizon ranges from dark yellowish brown (10YR 4/4) to yellowish brown (10YR 5/6) with grayish brown (10YR 5/2) or light brownish gray (10YR 6/2) mottles. Texture is silt loam or light silty clay loam. The C horizon is strongly acid or medium acid.

Gara series

The Gara series consists of moderately well drained or well drained, moderately slowly permeable soils. These soils are on the lower parts of side slopes on strongly dissected uplands. Gara soils formed in clay loam glacial till under mixed prairie grasses and trees. Slope ranges from 9 to 25 percent.

Typical pedon of Gara loam, 18 to 25 percent slopes, in woodland, 150 feet west and 340 feet north of the southeast corner of the NE1/4SE1/4 sec. 33, T. 77 N., R. 18 W.:

A1—0 to 7 inches; very dark brown (10YR 2/2) loam, dark gray (10YR 4/1) dry; black (10YR 2/1) coatings on peds; weak fine granular structure; friable; neutral; clear smooth boundary.

A2—7 to 11 inches; dark grayish brown (10YR 4/2) loam, pale brown (10YR 6/3) dry; very dark grayish brown (10YR 3/2) coatings on peds; weak thick platy structure parting to weak fine subangular blocky; friable; medium acid; clear smooth boundary.

B1—11 to 14 inches; brown (10YR 5/3) loam, light brownish gray (10YR 6/2) dry; faces of peds dark grayish brown (10YR 4/2); moderate fine subangular blocky structure; friable; continuous gray silt coatings; medium acid; clear smooth boundary.

B21t—14 to 20 inches; dark yellowish brown (10YR 4/4) loam; faces of peds brown (10YR 4/3); moderate fine and medium subangular blocky structure; firm; thin discontinuous clay films; discontinuous gray silt coatings; common coarse sand grains; strongly acid; gradual smooth boundary.

B22t—20 to 27 inches; yellowish brown (10YR 5/4) light clay loam; moderate medium subangular blocky structure; firm; thin discontinuous clay films on faces of peds; common pebbles; strongly acid; gradual smooth boundary.

B23t—27 to 35 inches; yellowish brown (10YR 5/4 and 5/6) light clay loam; weak medium prismatic structure parting to moderate medium subangular blocky; firm; clay fills in root channels and on vertical cleavage faces; a few pebbles; medium acid; gradual smooth boundary.

B3t—35 to 41 inches; coarsely mottled light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/6) loam; weak medium prismatic structure parting to weak medium and coarse subangular blocky; firm; common roots above a depth of 40 inches; a few clay fills on vertical cleavage faces; a few pebbles and small lime concretions; neutral; clear smooth boundary.

C—41 to 60 inches; coarsely mottled light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/6) light clay loam; massive; some vertical cleavage; friable; a few roots above a depth of 44 inches; common tubular pores; lime concretions; slightly effervescent; calcareous.

The solum ranges from 36 to 70 inches in thickness.

The A1 horizon is very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2) loam or silt loam. The A1 horizon is 6 to 10 inches thick and ranges from medium acid to neutral.

The A2 horizon is dark grayish brown (10YR 4/2) or very dark grayish brown (10YR 3/2) loam or silt loam. It is 4 to 8 inches thick and is medium acid or slightly acid.

The B22t horizon is brown (10YR 4/3) or yellowish brown (10YR 5/4) light or medium clay loam. The B22t horizon is 7 to 9 inches thick and is strongly acid or medium acid.

The C horizon ranges from dark yellowish brown (10YR 4/4) to brown (10YR 5/6). It is light clay loam or loam.

Givin series

The Givin series consists of somewhat poorly drained moderately slowly permeable soils. These soils are on broad upland divides and stream benches. Givin soils formed in moderately fine textured loess under mixed prairie grasses and trees. Slope ranges from 0 to 2 percent.

Typical pedon of Givin silt loam, 0 to 2 percent slopes, on an upland divide in a cultivated field, 28 feet north and 144 feet east of the southwest corner of the SE1/4NE1/4 sec. 1, T. 76 N., R. 19 W.:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; very dark

brown (10YR 2/2) coatings on peds; weak fine and medium granular structure; friable; medium acid; abrupt smooth boundary.

A2—8 to 13 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; very dark grayish brown (10YR 3/2) coatings on peds; weak thin and medium platy structure; friable; medium acid; abrupt smooth boundary.

B1—13 to 17 inches; dark grayish brown (10YR 4/2) and some brown (10YR 4/3) silty clay loam, light brownish gray (10YR 6/2) dry; faces of peds very dark grayish brown (10YR 3/2); moderate fine and medium subangular blocky structure; friable; thick discontinuous gray silt coatings; strongly acid; clear smooth boundary.

B21t—17 to 25 inches; brown (10YR 4/3) heavy silty clay loam, grayish brown (10YR 5/2) dry; common fine faint grayish brown (10YR 5/2) mottles; faces of peds dark grayish brown (10YR 4/2); strong fine and medium subangular blocky structure; firm; thick continuous clay films; thick continuous gray silt coatings; strongly acid; clear smooth boundary.

B22t—25 to 29 inches; grayish brown (10YR 5/2) silty clay loam; common fine and medium distinct yellowish brown (10YR 5/6) mottles; dark grayish brown (10YR 4/2) coatings on peds; moderate fine subangular blocky structure parting to moderate fine prismatic; firm; thick continuous clay films; thin discontinuous gray silt coatings; strongly acid; gradual smooth boundary.

B23t—29 to 45 inches; light olive gray (5Y 6/2) silty clay loam; many medium prominent yellowish brown (10YR 5/8) mottles; faces of peds grayish brown (2.5Y 5/2) and very dark grayish brown (10YR 3/2); weak medium prismatic structure; friable; roots extend to a depth of 43 inches; thin continuous clay films on vertical faces; few fine distinct soft black (10YR 2/1) oxides; medium acid; diffuse boundary.

B3t—45 to 62 inches; mottled yellowish brown (10YR 5/6) and light olive gray (5Y 6/2) silty clay loam; some vertical parting; friable; black (10YR 2/1) stains along vertical faces and root channels; thin discontinuous clay films on vertical faces; common fine distinct soft black (10YR 2/1) oxides; medium acid.

The solum thickness is typically more than 48 inches and ranges from 40 to 65 inches.

The Ap horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2). Texture is medium or heavy silt loam. The Ap horizon ranges from strongly acid to slightly acid.

The A2 horizon is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2) medium or heavy silt loam. The A2 horizon is 3 to 6 inches thick and ranges from strongly acid to slightly acid.

The B2t horizon is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2) and light olive gray (5Y 6/2) silty clay loam or light silty clay. The B2t horizon is 12 to 30 inches thick and is strongly acid or medium acid.

The B3t horizon ranges from grayish brown (2.5Y 5/2) to light olive gray (5Y 6/2) with common strong brown (7.5YR 5/6) or yellowish brown (10YR 5/6) mottles. Texture is light or medium silty clay loam. The B3t horizon is 6 to 20 inches thick and is strongly acid or medium acid.

Gosport series

The Gosport series consists of moderately well drained, very slowly permeable soils. These soils are on convex side slopes on uplands. Gosport soils formed in residuum weathered from gray and brown acid shale under forest. Slope ranges from 9 to 35 percent.

Typical pedon of Gosport silt loam, 18 to 25 percent slopes, moderately eroded, in pasture, 30 feet east and 400 feet north of the southwest corner of the NE1/4NW1/4 sec. 31, T. 75 N., R. 19 W.:

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) heavy silt loam, dark yellowish brown (10YR 4/4) dry; faces of peds very dark grayish brown (10YR 3/2); moderate fine granular structure; friable; neutral; abrupt smooth boundary.

B1—6 to 9 inches; grayish brown (10YR 5/2) heavy silty clay loam; common fine distinct yellowish brown (10YR 5/4) mottles; strong very fine subangular blocky structure and angular blocky structure; firm; very strongly acid; clear smooth boundary.

B2—9 to 17 inches; mottled light brownish gray (2.5Y 6/2) and brownish yellow (10YR 6/6) silty clay; some faces of peds grayish brown (10YR 5/2); weak coarse platy structure parting to weak very fine subangular blocky and angular blocky structure; very firm; very strongly acid; gradual smooth boundary.

B3—17 to 26 inches; gleyed greenish gray to light greenish gray (5GY 6/1 or 7/1) heavy silty clay; common coarse prominent reddish brown (2.5YR 4/4) mottles; weak medium angular blocky structure; very firm; medium acid; gradual smooth boundary.

Cr—26 to 43 inches; coarsely mottled light yellowish brown (2.5Y 6/4) and light gray (5Y 7/2) clay shale; weak medium platy structure; very firm; common roots above a depth of 35 inches; neutral.

Solum thickness is typically 20 to 30 inches but ranges to 40 inches.

The Ap horizon ranges from very dark gray (10YR 3/1) to dark grayish brown (10YR 4/2). Texture is typically silt loam but in places is silty clay loam, loam, sandy loam, and clay loam.

The B2 horizon ranges from light olive brown (2.5Y 5/3) to mottled light brownish gray (2.5Y 6/2) and

brownish yellow (10YR 6/6). Texture is silty clay or clay. The B2 horizon is 6 to 12 inches thick and ranges from extremely acid to strongly acid.

The C horizon is variable in color. Hue ranges from 7.5YR to 5Y. Value ranges from 0 to 8 and chroma from 2 to 6. Texture is clay shale with thin strata of sandstone or siltstone.

Grundy series

The Grundy series consists of somewhat poorly drained, slowly permeable soils. These soils are on wide upland ridgetops. Grundy soils formed in moderately fine textured loess under prairie grasses. Slope ranges from 2 to 5 percent.

These soils are outside the defined range of the Grundy series because they do not have enough clay in the subsoil. This difference does not alter their use or behavior.

Typical pedon of Grundy silty clay loam, 2 to 5 percent slopes, on an upland divide in a cultivated field, 76 feet north and 20 feet west of the southeast corner of the SW1/4NW1/4 of sec. 25, T. 74 N., R. 21 W.:

Ap—0 to 9 inches; very dark brown (10YR 2/2) silty clay loam, dark gray (10YR 4/1) dry; black (10YR 2/1) coatings on peds; weak fine granular structure; friable; neutral; gradual smooth boundary.

A12—9 to 13 inches; very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2) medium silty clay loam, dark gray (10YR 4/1) dry; black (10YR 2/1) coatings on peds; moderate fine granular structure; friable; neutral gradual smooth boundary.

B1—13 to 17 inches; dark grayish brown (10YR 4/2) silty clay loam; faces of peds very dark grayish brown (10YR 3/2); gray (10YR 5/1) coatings on peds, dry; moderate very fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.

B21t—17 to 22 inches; dark grayish brown (10YR 4/2) heavy silty clay loam; common fine faint dark yellowish brown (10YR 4/4) mottles; faces of peds very dark grayish brown (10YR 3/2); weak medium prismatic structure parting to moderate fine subangular blocky; firm; thick discontinuous clay films; slightly acid; gradual smooth boundary.

B22t—22 to 30 inches; grayish brown (2.5Y 5/2) light silty clay common medium distinct yellowish brown (10YR 5/6) mottles; dark gray (10YR 4/1) coatings on peds; weak medium prismatic structure parting to moderate medium subangular blocky; firm; thick discontinuous clay films; slightly acid; diffuse boundary.

B23t—30 to 37 inches; grayish brown (2.5Y 5/2) heavy silty clay loam; common medium distinct brown (7.5YR 4/4) and strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; thin discontinuous clay films; common soft black oxides; slightly acid; diffuse boundary.

B31t—37 to 51 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium distinct dark brown (7.5YR 4/4) and strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to weak coarse subangular blocky; friable; few roots to above a depth of 45 inches; thin discontinuous clay films; common soft black oxides; slightly acid; diffuse boundary.

B32—51 to 62 inches; light brownish gray (2.5Y 6/2) silty clay loam; common medium distinct brown (7.5YR 4/4) and strong brown (7.5YR 5/6) mottles; weak coarse subangular blocky structure; friable; neutral.

The solum is 3 1/2 to 8 feet thick.

The Ap horizon is black (10YR 2/1) or very dark brown (10YR 2/2). Texture ranges from heavy silt loam to medium silty clay loam. The Ap horizon is 6 to 9 inches thick and is neutral or slightly acid.

The B1 horizon ranges from very dark gray (10YR 3/1) to dark grayish brown (10YR 4/2). Texture is medium or heavy silty clay loam. The B1 horizon is 4 to 6 inches thick and is medium acid or slightly acid.

The B22t horizon is grayish brown (2.5Y 5/2) or dark grayish brown (10YR 4/2). Texture is heavy silty clay loam or light silty clay. The B22t horizon is 6 to 8 inches thick and ranges from strongly acid to slightly acid.

The B31t horizon is medium or heavy silty clay loam. It is 10 to 14 inches thick and is slightly acid or neutral.

Haig series

The Haig series consists of poorly drained, slowly permeable or very slowly permeable soils. These soils are on broad upland divides. Haig soils formed in moderately fine textured loess under water-tolerant prairie grasses. Slope ranges from 0 to 2 percent.

Typical pedon of Haig silt loam, 0 to 2 percent slopes, on an upland divide in a cultivated field, 52 feet north and 480 feet east of the southwest corner of the SE1/4NW1/4 sec. 25, T. 74 N., R. 21 W.:

Ap—0 to 7 inches; black (10YR 2/1) heavy silt loam; cloddy parting to weak fine granular structure; friable; neutral; abrupt smooth boundary.

A12—7 to 11 inches; black (10YR 2/1) light silty clay loam; weak fine subangular blocky structure parting to weak fine granular; friable; slightly acid; gradual smooth boundary.

A3—11 to 14 inches; black (10YR 2/1) silty clay loam; moderate fine subangular blocky structure parting to weak fine granular; firm; slightly acid; gradual smooth boundary.

B1tg—14 to 17 inches; very dark gray (10YR 3/1) silty clay loam; moderate fine subangular blocky struc-

ture; firm; few thin discontinuous black (10YR 2/1) clay films; neutral; clear smooth boundary.

B21tg—17 to 22 inches; very dark gray (10YR 3/1) heavy silty clay loam; common fine faint yellowish brown (10YR 5/4) mottles; moderate fine subangular blocky structure; firm; thick continuous black (10YR 2/1) clay films; slightly acid; gradual smooth boundary.

B22tg—22 to 29 inches; olive gray (5Y 4/2) light silty clay; many fine distinct yellowish brown (10YR 5/4) and few fine distinct grayish brown (2.5Y 5/2) mottles; faces of peds dark gray (5Y 4/1); moderate fine subangular blocky structure; firm; very dark grayish brown (10YR 3/2) in clayey deposits in root channels; thick continuous clay films; slightly acid; gradual smooth boundary.

B23tg—29 to 37 inches; olive gray (5Y 5/2) heavy silty clay loam; few fine distinct yellowish brown (10YR 5/4) and common fine distinct yellowish brown (10YR 5/6) mottles; faces of peds olive gray (5Y 4/2); weak fine prismatic structure parting to moderate fine subangular blocky; firm; dark olive gray (10YR 3/2) clayey deposits in root channels; thick continuous clay films on prism faces; slightly acid; gradual smooth boundary.

B31tg—37 to 44 inches; olive gray (5Y 5/2) heavy silty clay loam; common fine distinct strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to moderate fine subangular blocky; firm; black (10YR 2/1) clayey deposits in root channels; thick continuous clay films on prism faces; few black oxides; slightly acid; gradual smooth boundary.

B32tg—44 to 50 inches; light olive gray (5Y 6/2) silty clay loam; common medium distinct strong brown (7.5YR 5/6) and few fine distinct yellowish brown (10YR 5/4) mottles; weak medium prismatic structure; firm; black (10YR 2/1) clayey deposits in root channels; thick continuous clay films; many black oxides; slightly acid; gradual smooth boundary.

Cg—50 to 60 inches; light olive gray (5Y 6/2) silty clay loam; few medium distinct strong brown (7.5YR 5/6) and few fine distinct yellowish brown (10YR 5/4) mottles; massive; firm; black (10YR 2/1) in root channels; neutral.

Solum thickness is typically more than 60 inches and ranges from 50 to 70 inches.

The Ap horizon is black (10YR 2/1) or very dark gray (10YR 3/1). Texture is heavy silt loam or light silty clay loam. The Ap horizon ranges from medium acid to neutral.

B2tg horizon ranges from very dark gray (10YR 3/1) to olive gray (5Y 5/2). Texture is light or medium silty clay. The B2tg horizon is 20 to 30 inches thick and ranges from strongly acid to neutral.

The B3tg horizon is 13 to 26 inches thick and ranges from strongly acid to slightly acid.

Huntsville series

The Huntsville series consists of well drained and moderately well drained, moderately permeable soils. These soils are on low stream terraces slightly above the present flood plain. Huntsville soils formed in medium textured alluvium under prairie grasses. Slope ranges from 0 to 2 percent.

Typical pedon of Huntsville silt loam, 0 to 2 percent slopes, on a low bench in a cultivated field, 1,160 feet west and 141 feet south of the northeast corner of sec. 15, T. 74 N., R. 18 W.:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; neutral; gradual smooth boundary.

A12—9 to 18 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate very fine subangular blocky structure; friable; neutral; gradual smooth boundary.

A13—18 to 24 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; faces of peds very dark brown (10YR 2/2); moderate fine subangular blocky structure; friable; neutral; gradual smooth boundary.

A14—24 to 29 inches; dark brown (10YR 3/3) silt loam, grayish brown (10YR 5/2) dry; faces of peds very dark grayish brown (10YR 3/2); moderate fine subangular blocky structure; friable; neutral; gradual smooth boundary.

C1—29 to 40 inches; brown (10YR 4/3) silt loam; faces of peds dark brown (10YR 3/3); moderate medium subangular blocky structure; firm; common fine sand grains; neutral; diffuse boundary.

C2—40 to 50 inches; brown (10YR 4/3) and dark yellowish brown (10YR 4/4) loam; weak medium subangular blocky structure; firm; common fine sand grains; neutral; diffuse boundary.

C3—50 to 60 inches; yellowish brown (10YR 5/4) loam; faces of peds dark grayish brown (10YR 4/2); weak coarse subangular blocky structure; friable; common fine sand grains; slightly acid.

The Ap horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2). Texture is heavy silt loam or light silty clay loam. The Ap horizon is 5 to 10 inches thick and is slightly acid or neutral.

The A12 horizon ranges from very dark brown (10YR 2/2) to very dark gray (10YR 3/1). Texture is heavy silt loam or light silty clay loam. The A12 horizon is 6 to 9 inches thick and ranges from medium acid to neutral.

Judson series

The Judson series consists of well drained and moderately well drained, moderately permeable soils. These

soils are on slightly concave low foot slopes and on nearly level fans where waterways empty onto the bottom lands. Judson soils formed in moderately fine textured local alluvium washed from adjacent loess-covered areas. The native vegetation was prairie grasses. Slope ranges from 2 to 9 percent.

Typical pedon of Judson silty clay loam, 2 to 5 percent slopes, on a foot slope in a cultivated field, 666 feet south and 225 feet east of the northwest corner of the NW1/4NE1/4 sec. 25, T. 77 N., R. 19 W.:

Ap—0 to 8 inches; very dark brown (10YR 2/2) light silty clay loam, dark grayish brown (10YR 4/2) dry; black (10YR 2/1) coatings on peds; weak fine granular structure; firm; medium acid; abrupt smooth boundary.

A12—8 to 17 inches; very dark brown (10YR 2/2) light silty clay loam, dark grayish brown (10YR 4/2) dry; black (10YR 2/1) coatings on peds; moderate fine granular structure; friable; medium acid; clear smooth boundary.

A13—17 to 25 inches; very dark grayish brown (10YR 3/2) light silty clay loam, grayish brown (10YR 5/2) dry; very dark gray (10YR 3/1) coatings on peds; moderate medium and coarse granular structure; friable; slightly acid; gradual smooth boundary.

B21—25 to 32 inches; very dark grayish brown (10YR 3/2) light silty clay loam, grayish brown (10YR 5/2) dry; faces of peds very dark gray (10YR 3/1); moderate fine and medium subangular blocky structure; firm; neutral; clear smooth boundary.

B22—32 to 43 inches; dark brown (10YR 3/3) light silty clay loam; faces of peds very dark grayish brown (10YR 3/2); weak medium prismatic structure parting to weak fine subangular blocky; firm; neutral; gradual smooth boundary.

B23—43 to 50 inches; brown (10YR 4/3) silty clay loam; faces of peds dark brown (10YR 3/3); some vertical parting; firm; some organic staining on root channels; neutral; diffuse smooth boundary.

B3—50 to 60 inches; brown (10YR 5/3) silty clay loam; faces of peds brown (10YR 4/3); some vertical parting; firm; few fine roots above a depth of 51 inches; some organic staining on root channels; 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) in the upper part. Texture of the A horizon is silt loam or light silty clay loam. The A horizon is 24 to 30 inches thick.

The B22 horizon is very dark grayish brown (10YR 3/2) or dark brown (10YR 3/3). Texture is light or medium silty clay loam. The B22 horizon is 5 to 12 inches thick and is neutral or slightly acid.

The B3 horizon is brown (10YR 4/3 or 5/3). Texture is light or medium silty clay loam. The B3 horizon is 8 to 12 inches thick and is neutral or slightly acid in reaction.

Kennebec series

The Kennebec series consists of moderately well drained, moderately permeable soils. These soils are on first bottoms near the main stream channel. Kennebec soils formed in medium textured alluvium under prairie grasses. Slope ranges from 0 to 2 percent.

Typical pedon of Kennebec silt loam, 0 to 2 percent slopes, in a cultivated field, 50 feet north and 50 feet west of the southeast corner of the SW1/4SW1/4 sec. 9, T. 77 N., R. 21 W.:

Ap—0 to 9 inches; very dark gray (10YR 3/1) silt loam; cloddy parting to weak medium granular structure; friable; neutral; clear smooth boundary.

A12—9 to 18 inches; black (10YR 2/1) and very dark gray (10YR 3/1) silt loam; weak very fine subangular blocky structure parting to moderate medium granular; friable; neutral; gradual smooth boundary.

A13—18 to 30 inches; very dark gray (10YR 3/1) heavy silt loam; black (10YR 2/1) coatings on peds; weak fine subangular blocky structure parting to moderate medium granular; friable; common roots above a depth of 24 inches; neutral; gradual smooth boundary.

AC—30 to 44 inches; very dark grayish brown (10YR 3/2) light silty clay loam; very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) coatings on peds; weak medium subangular blocky structure; friable; some coarse sand grains; neutral; diffuse boundary.

C—44 to 60 inches; dark grayish brown (10YR 4/2) light silty clay loam; very dark grayish brown (10YR 3/2) coatings on peds; weak medium subangular blocky structure; friable; some coarse sand grains; neutral.

The solum is more than 36 inches thick.

The Ap horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2). Texture ranges from light to heavy silt loam. The Ap horizon is slightly acid or neutral.

The C horizon ranges from very dark gray (10YR 3/1) to dark grayish brown (10YR 4/2).

Ladoga series

The Ladoga series consists of moderately well drained, moderately permeable soils. These soils are on side slopes and ridgetops on upland divides and on benches adjacent to major streams. Ladoga soils formed in moderately fine textured loess under mixed prairie grasses and trees. Slope ranges from 2 to 14 percent.

Typical pedon of Ladoga silt loam, 2 to 5 percent slopes, on a ridgetop in permanent pasture, 112 feet east and 550 feet south of the northwest corner of the SW1/4NW1/4 sec. 1, T. 76 N., R. 18 W.:

A1—0 to 9 inches; very dark gray (10YR 3/1) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; neutral; clear smooth boundary.

A2—9 to 12 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; very dark grayish brown (10YR 3/2) coatings on peds; weak thick platy structure parting to moderate fine subangular blocky; friable; slightly acid; clear smooth boundary.

B1—12 to 18 inches; brown (10YR 4/3) light silty clay loam, light brownish gray (10YR 6/2) dry; faces of peds very dark grayish brown (10YR 3/2); moderate very fine and fine subangular blocky and angular blocky structure; friable; common gray silt coatings; medium acid; gradual smooth boundary.

B21t—18 to 24 inches; brown (10YR 4/3) heavy silty clay loam; moderate fine and medium subangular blocky structure and angular blocky structure; firm; thin continuous clay films; slightly acid; gradual smooth boundary.

B22t—24 to 34 inches; yellowish brown (10YR 5/4) silty clay loam; few medium faint yellowish brown (10YR 5/6) and light brownish gray (2.5Y 6/2) mottles in lower part; weak medium prismatic structure parting to moderate medium subangular blocky and angular blocky; firm; thin continuous and thick discontinuous clay films; slightly acid; gradual smooth boundary.

B31t—34 to 43 inches; brown (10YR 5/3) silty clay loam; common medium distinct light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/6) mottles; faces of peds brown (10YR 4/3); weak medium prismatic structure parting to weak medium subangular blocky; friable; thin continuous clay films on prism faces; slightly acid; diffuse boundary.

B32t—43 to 60 inches; mottled light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/6) light silty clay loam; weak medium prismatic structure; friable; thin discontinuous clay films; slightly acid.

The solum ranges from 3 to 6 feet in thickness.

The A1 horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2). Texture is medium or heavy silt loam. The A1 horizon is 6 to 10 inches thick and ranges from medium acid to neutral.

The A2 horizon is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2). Texture is medium or heavy silt loam. The A2 horizon is 2 to 6 inches thick and ranges from medium acid to neutral.

The B2t horizon ranges from brown (10YR 4/3) to yellowish brown (10YR 5/4). Texture is medium or heavy silty clay loam. The B2t horizon is 16 to 32 inches thick and ranges from strongly acid to slightly acid.

The B3t horizon ranges from brown (10YR 5/3) to mottled light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/6). Texture is medium or light silty clay loam. The B3t horizon is 15 to 30 inches thick and ranges from strongly acid to slightly acid.

In map units 76C2 and 76D2, the epipedon is too thin and in places too light in color for the soil to be a Mollic intergrade.

Lamoni series

The Lamoni series consists of somewhat poorly drained, slowly permeable or very slowly permeable soils. These soils are on lower parts of side slopes adjacent to upland divides. Lamoni soils formed in moderately fine textured and fine textured weathered glacial till under prairie grasses. Slope ranges from 9 to 14 percent.

Typical pedon of Lamoni silty clay loam, 9 to 14 percent slopes, moderately eroded, on an upland side slope in a meadow, 460 feet south and 60 feet west of the northeast corner of sec. 16, T. 77 N., R. 19 W.:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) and some grayish brown (10YR 4/2) silty clay loam, grayish brown (10YR 5/2) dry; cloddy parting to moderate fine subangular blocky structure; friable; neutral; clear smooth boundary.

B1—8 to 11 inches; dark grayish brown (2.5Y 4/2) silty clay loam; faces of peds very dark grayish brown (2.5Y 3/2); moderate fine subangular blocky structure; firm; neutral; clear smooth boundary.

IIB21t—11 to 17 inches; grayish brown (2.5Y 5/2) clay loam; faces of peds dark grayish brown (2.5Y 4/2); moderate fine subangular blocky structure; very firm; thick discontinuous clay films; common pebbles; small krotovinas; slightly acid; gradual smooth boundary.

IIB22t—17 to 22 inches; grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4) clay loam; moderate fine subangular blocky structure; very firm; few roots; thick discontinuous clay films; common pebbles; small krotovinas; medium acid; gradual smooth boundary.

IIB31t—22 to 28 inches; coarsely mottled olive (5Y 5/3) and dark grayish brown (2.5Y 4/2) heavy clay loam; common medium distinct light olive brown (2.5Y 5/6) and yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; thin discontinuous clay films; common pebbles; medium acid; gradual smooth boundary.

IIB32t—28 to 39 inches; coarsely mottled strong brown (7.5YR 5/6) and light olive gray (5Y 6/2) heavy clay loam; weak medium subangular blocky structure; firm; thin discontinuous clay films; common pebbles; neutral; gradual smooth boundary.

IIB33t—39 to 47 inches; mottled yellowish brown (10YR 5/6) and light olive gray (5Y 6/2) clay loam; weak coarse subangular blocky structure; firm; thin discontinuous clay films; common pebbles; neutral; diffuse boundary.

IIC—47 to 60 inches; yellowish brown (10YR 5/6) loam; common coarse distinct light olive gray (5Y 6/2) mottles; massive; firm; common soft calcareous concretions; common pebbles; mildly alkaline.

The Ap horizon ranges from very dark grayish brown (10YR 3/2) to very dark gray (10YR 3/1). Texture is silt loam, silty clay loam, clay loam, or loam. The Ap horizon is 6 to 10 inches thick and is medium acid to neutral.

The B1 horizon ranges from brown (10YR 4/3) to dark grayish brown (2.5Y 4/2). Texture ranges from medium silty clay loam to light clay. The B1 horizon is 3 to 6 inches thick and is medium acid to neutral.

The IIB2t horizon is grayish brown (2.5Y or 10YR 5/2). Texture is medium or heavy clay loam. The IIB2t horizon is 11 to 24 inches thick.

The mottles in the IIC horizon are light gray (5Y 6/1), strong brown (7.5YR 5/8), and light olive gray (5Y 6/2). Texture of the C horizon is light clay loam or loam.

Landes series

The Landes series consists of well drained, rapidly permeable soils. These soils are on wide river bottom lands adjacent to present and former stream channels. Landes soils formed in recent stratified alluvium that is mostly moderately coarse textured. They formed under mixed prairie grasses and trees. Slope ranges from 0 to 2 percent.

Typical pedon of Landes loam, 0 to 2 percent slopes, on bottom land in a meadow, 30 feet south and 800 feet west of the northeast corner of sec. 30, T. 76 N., R. 18 W.:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

A12—8 to 18 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak very fine subangular blocky structure; friable; neutral; gradual smooth boundary.

C1—18 to 26 inches; dark grayish brown (10YR 4/2) loamy fine sand, grayish brown (2.5Y 5/2) dry; massive; very friable; neutral; clear smooth boundary.

C2—26 to 37 inches; stratified very dark grayish brown (10YR 3/2) and grayish brown (10YR 5/2) loam and loamy fine sand; massive; friable; neutral; gradual smooth boundary.

C3—37 to 42 inches; light brownish gray (10YR 6/2) fine sand; single grain; loose; neutral; gradual smooth boundary.

C4—42 to 60 inches; grayish brown (10YR 5/2) loamy fine sand; massive; very friable; neutral; clear smooth boundary.

C5—50 to 60 inches; very dark grayish brown (10YR 3/2) loam; massive; friable; neutral.

The solum ranges from 10 to 20 inches in thickness.

The A horizon is very dark grayish brown (10YR 3/2) or dark brown (10YR 3/3). Texture ranges from loam to fine sandy loam. The A horizon is 10 to 20 inches thick and is neutral to mildly alkaline.

Texture of the strata in the substratum ranges from sand to silt loam. The substratum ranges from neutral to mildly alkaline.

Lindley series

The Lindley series consists of well drained, moderately slowly permeable soils. These soils are on the lower parts of side slopes on strongly dissected upland divides. Lindley soils formed in clay loam glacial till under forest. Slope ranges from 9 to 25 percent.

Typical pedon of Lindley loam, 14 to 18 percent slopes, on a side slope in woodland, 500 feet west and 200 feet north of the southeast corner of the NE1/4SW1/4 sec. 33, T. 77 N., R. 19 W.:

A1—0 to 7 inches; very dark grayish brown (10YR 3/2) loam, light brownish gray (10YR 6/2) dry; weak very thick platy structure parting to weak fine granular; friable; strongly acid; clear smooth boundary.

A2—7 to 10 inches; dark grayish brown (10YR 4/2) loam, light gray (10YR 7/2) dry; weak thick platy structure parting to weak fine granular; friable; strongly acid; clear smooth boundary.

B1—10 to 15 inches; brown (7.5YR 5/4) loam, very pale brown (10YR 7/3) dry; faces of peds yellowish brown (10YR 5/4) and brown (10YR 5/3); moderate medium and fine subangular blocky structure; friable; abundant gray silt coatings; strongly acid; gradual smooth boundary.

B21t—15 to 21 inches; yellowish brown (10YR 5/6) heavy clay loam; a few faces of peds brown (10YR 5/3); moderate fine angular and subangular blocky structure; firm; common gray silt coatings; few thin discontinuous clay films; strongly acid; clear smooth boundary.

B22t—21 to 28 inches; yellowish brown (10YR 5/4) and strong brown (7.5YR 5/6) clay loam, very pale brown (10YR 8/3) dry; moderate medium subangular blocky structure; firm; abundant gray silt coatings; few thin discontinuous clay films; very strongly acid; clear smooth boundary.

B23t—28 to 37 inches; strong brown (7.5YR 5/6) clay loam; weak medium prismatic structure parting to moderate medium and coarse subangular blocky; firm; roots above a depth of 47 inches; common thick dark brown (7.5YR 4/2) clay films on vertical faces; common coarse sand grains; common fine and medium black oxides; strongly acid; diffuse boundary.

B31t—37 to 47 inches; strong brown (7.5YR 5/6) clay loam; common medium distinct light brownish gray

(2.5Y 6/2) mottles; weak medium prismatic structure; firm; thin discontinuous grayish brown (10YR 5/2) clay films on vertical faces; strongly acid; diffuse boundary.

B32—47 to 56 inches; yellowish brown (10YR 5/6) clay loam; common coarse distinct strong brown (7.5YR 5/6) mottles and common fine distinct light brownish gray (2.5Y 6/2) mottles; weak medium prismatic structure; firm; few tubular pores above a depth of 56 inches; common coarse sand grains and large pebbles; strongly acid; diffuse boundary.

C—56 to 60 inches; yellowish brown (10YR 5/6) clay loam; common medium distinct light olive gray (5Y 6/2) mottles; massive; friable to firm; common coarse sand grains and large pebbles; neutral.

The solum ranges from 30 to 60 inches in thickness.

The A1 horizon ranges from very dark gray (10YR 3/1) to dark grayish brown (10YR 4/2). Texture is mostly loam but in places is silt loam or light clay loam. The A1 horizon is 1 to 7 inches thick and ranges from strongly acid to slightly acid.

The A2 horizon ranges from dark grayish brown (10YR 4/2) to light yellowish brown (10YR 6/4). Texture is typically loam but in places is silt loam. The A2 horizon is 2 to 7 inches thick and ranges from very strongly acid to medium acid.

The B2t horizon ranges from dark yellowish brown (10YR 4/4) or brown (7.5YR 4/4) to yellowish brown (10YR 5/6) or strong brown (7.5YR 5/6). Texture ranges from light to heavy clay loam. The B2t horizon is 1 to 4 feet thick and ranges from very strongly acid to slightly acid.

The C horizon is yellowish brown (10YR 5/6) or strong brown (7.5YR 5/6). Mottles range from light gray to brown. Texture is heavy loam to medium clay loam. The C horizon ranges from medium acid to moderately alkaline.

Macksburg series

The Macksburg series consists of somewhat poorly drained, moderately permeable soils. These soils are on wide divides and high benches along the major streams. Macksburg soils formed in loess under prairie grasses. Slope ranges from 0 to 5 percent.

Typical pedon of Macksburg silty clay loam, 0 to 2 percent slopes, on a broad upland divide in a cultivated field, 131 feet east and 418 feet south of northwest corner of SE1/4SE1/4 sec. 22, T. 76 N., R. 21 W.:

Ap—0 to 10 inches; black (10YR 2/1) light silty clay loam; weak very fine granular structure; friable; slightly acid; clear smooth boundary.

A12—10 to 19 inches; black (10YR 2/1) medium silty clay loam; black (10YR 2/1) coatings on peds; moderate fine granular structure; friable; slightly acid; gradual smooth boundary.

A3—19 to 24 inches; very dark grayish brown (10YR 3/2) silty clay loam; faces of peds black (10YR 2/1) and very dark gray (10YR 3/1); moderate very fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.

B1—24 to 31 inches; dark grayish brown (10YR 4/2) heavy silty clay loam; faces of peds black (10YR 2/1) and very dark gray (10YR 3/1); moderate fine subangular blocky structure; firm; slightly acid; gradual smooth boundary.

B21t—31 to 39 inches; grayish brown (2.5Y 5/2) heavy silty clay loam; common fine prominent yellowish brown (10YR 5/4) and strong brown (7.5YR 5/8) mottles; a few faces of peds in upper part very dark gray (10YR 3/2); weak medium prismatic structure parting to moderate fine and medium subangular blocky; firm; thin discontinuous clay films; common medium strong brown soft oxides; medium acid; gradual smooth boundary.

B22t—39 to 47 inches; light brownish gray (2.5Y 6/2) silty clay loam; common medium prominent yellowish brown (10YR 5/4) and strong brown (7.5YR 5/8) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; thin discontinuous clay films; medium acid; gradual smooth boundary.

B3—47 to 55 inches; olive gray (5Y 5/2) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; friable; roots common above a depth of 50 inches; some dark grayish brown (10YR 4/2) coatings on peds; medium acid; diffuse boundary.

C1—55 to 67 inches; light olive gray (5Y 6/2) silty clay loam; common medium prominent strong brown (7.5YR 5/8) mottles; massive; friable; few roots above a depth of 60 inches; dark grayish brown (2.5Y 4/2) coatings in root channels and on vertical cleavage faces; slightly acid; diffuse boundary.

C2—67 to 88 inches; light olive gray (5Y 6/2) light silty clay loam; common coarse distinct yellowish brown (10YR 5/6) mottles; massive; common fine tubular pores; very dark gray (10YR 3/1) organic stains; slightly acid.

The solum ranges from 48 to 84 inches in thickness.

The A1 horizon is black (10YR 2/1) or very dark brown (10YR 2/2). It is 10 to 20 inches thick and ranges from strongly acid to slightly acid.

The B2t horizon ranges from dark grayish brown (10YR 4/2) to light brownish gray (2.5Y 6/2). Texture ranges from medium silty clay loam to light silty clay. The B2t horizon is 14 to 24 inches thick and is strongly acid or medium acid.

The C horizon ranges from dark grayish brown (2.5Y 4/2) to light olive gray (5Y 6/2). Texture is light or

medium silty clay loam. The C horizon is slightly acid or neutral.

Mahaska series

The Mahaska series consists of somewhat poorly drained, moderately permeable soils. These soils are on wide, nearly flat upland divides. Mahaska soils formed in loess under prairie grasses. Slope ranges from 1 to 3 percent.

Typical pedon of Mahaska silty clay loam, 1 to 3 percent slopes, on a broad upland divide in a cultivated field, 460 feet east and 420 feet south of the northwest corner of the SW1/4SW1/4 sec. 12, T. 76 N., R. 18 W.:

Ap—0 to 8 inches; black (10YR 2/1) light silty clay loam, gray (10YR 5/1) dry; weak fine granular structure; friable; slightly acid; clear smooth boundary.

A12—8 to 14 inches; black (10YR 2/1) silty clay loam, gray (10YR 5/1) dry; moderate fine and medium granular structure; friable; slightly acid; gradual smooth boundary.

A3—14 to 19 inches; very dark grayish brown (10YR 3/2) silty clay loam, gray (10YR 5/1) dry; very dark gray (10YR 3/1) coatings on peds; moderate very fine granular structure; friable; medium acid; gradual smooth boundary.

B1—19 to 23 inches; dark grayish brown (2.5Y 4/2) silty clay loam, grayish brown (10YR 5/2) dry; faces of peds very dark grayish brown (10YR 3/2); moderate very fine subangular blocky structure; friable; medium acid; gradual smooth boundary.

B21t—23 to 28 inches; dark grayish brown (2.5Y 4/2) heavy silty clay loam, light brownish gray (10YR 6/2) dry; faces of peds very dark grayish brown (10YR 3/2); moderate fine subangular blocky structure; friable; thin discontinuous clay films; medium acid; gradual smooth boundary.

B22t—28 to 32 inches; dark grayish brown (2.5Y 4/2) silty clay loam; few medium distinct grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate very fine and fine subangular blocky; friable; thin discontinuous clay films; medium acid; gradual smooth boundary.

B23t—32 to 38 inches; brown (10YR 5/3) silty clay loam; common medium distinct grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; friable; thin discontinuous clay films; slightly acid; clear smooth boundary.

B31t—38 to 45 inches; coarsely mottled strong brown (7.5YR 5/8) and light brownish gray (2.5Y 6/2) silty clay loam; weak medium prismatic structure parting to weak medium subangular blocky; friable; common roots above a depth of 42 inches; thick and thin discontinuous clay films; slightly acid; clear smooth boundary.

B32t—45 to 60 inches; light gray (5Y 6/1) silty clay loam; common medium distinct strong brown (10YR 5/6) mottles; weak coarse prismatic structure parting to weak coarse subangular blocky; friable; few roots above a depth of 53 inches; clay fills in root channels; neutral; diffuse boundary.

C—60 to 72 inches; mottled light gray (5Y 6/1) and yellowish brown (10YR 5/6) silty clay loam; massive; friable; neutral at a depth of 70 inches.

The solum ranges from 48 to 72 inches in thickness. The A1 horizon is black (10YR 2/1), very dark brown (10YR 2/2), or very dark gray (10YR 3/1). Texture ranges from heavy silt loam to medium silty clay loam. The A1 horizon is 7 to 15 inches thick and is medium acid or slightly acid.

Texture of the B2t horizon ranges from medium silty clay loam to light silty clay. The B2t horizon is 14 to 24 inches thick and ranges from slightly acid to strongly acid.

The C horizon ranges from silty clay loam to silt loam.

Muscatine series

The Muscatine series consists of somewhat poorly drained, moderately permeable soils. These soils are on broad upland ridgetops. Muscatine soils formed in loess under prairie grasses. Slope ranges from 0 to 2 percent.

Typical pedon of Muscatine silty clay loam, 0 to 2 percent slopes, on a broad upland divide in a cultivated field, 640 feet east and 580 feet north of the southwest corner of the SE1/4NW1/4 sec. 16, T. 77 N., R. 18 W.:

Ap—0 to 7 inches; very dark gray (10YR 3/1) light silty clay loam, dark grayish brown (10YR 4/2) dry; black (10YR 2/1) coatings on peds; weak very fine granular structure; friable; strongly acid; abrupt smooth boundary.

A12—7 to 14 inches; very dark gray (10YR 3/1) light silty clay loam, grayish brown (10YR 5/2) dry; black (10YR 2/1) coatings on peds; weak fine granular structure; friable; strongly acid; clear smooth boundary.

A13—14 to 19 inches; very dark grayish brown (10YR 3/2) light silty clay loam, grayish brown (10YR 5/2) dry; very dark brown (10YR 2/2) coatings on peds; moderate fine and medium granular structure parting to weak very fine angular blocky; friable; medium acid; gradual smooth boundary.

A3—19 to 25 inches; dark grayish brown (10YR 4/2) silty clay loam, brown (10YR 5/3) dry; very dark gray (10YR 3/1) coatings on peds; moderate coarse granular structure; firm; medium acid; clear smooth boundary.

B21t—25 to 31 inches; grayish brown (2.5Y 5/2) silty clay loam, pale brown (10YR 6/3) dry; some faces of peds very dark gray (10YR 3/1); moderate medium and coarse granular structure parting to weak fine prismatic; firm; thin discontinuous clay films; slightly acid; gradual smooth boundary.

B22t—31 to 40 inches; grayish brown (2.5Y 5/2) light silty clay loam; few fine faint yellowish brown (10YR 5/8) mottles; a few faces of peds brown (10YR 4/3); weak medium prismatic structure; friable; thin discontinuous clay films; slightly acid; gradual smooth boundary.

B3t—40 to 49 inches; yellowish brown (10YR 5/4) light silty clay loam; common fine and medium distinct yellowish brown (10YR 5/8) mottles; some vertical cleavage; friable; thin discontinuous clay films; neutral; diffuse smooth boundary.

C—49 to 60 inches; olive (5Y 5/3) light silty clay loam; many medium prominent brown (7.5YR 4/4) mottles; some vertical cleavage; friable; neutral.

The solum thickness is typically about 48 inches but ranges from 40 to 60 inches.

The A1 horizon is 12 to 25 inches thick.

The B2t horizon is dark grayish brown (10YR 4/2), brown (10YR 4/3), or grayish brown (2.5Y 5/2). It is 15 to 25 inches thick and is medium acid to slightly acid.

The C horizon is grayish brown (10YR 5/2), brown (10YR 5/3), light brownish gray (10YR 6/2), and olive (5Y 5/3). Texture is silt loam or light silty clay loam. The C horizon is neutral or mildly alkaline.

Mystic series

The Mystic series consists of somewhat poorly drained, slowly permeable soils. These soils are at the ends of low convex ridgetops that grade to major stream valleys. Mystic soils formed in a red clay paleosol mixed prairie grasses and trees. The paleosol had previously formed in old alluvium. Slope ranges from 9 to 14 percent.

Typical pedon of Mystic loam, in an area of Caleb-Mystic loams, 9 to 14 percent slopes, moderately eroded, on the side of a high bench in a cultivated field, 180 feet east and 760 feet north of the southwest corner of sec. 28, T. 74 N., R. 19 W.:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; few fine distinct brown (10YR 4/3) mottles; weak fine granular structure; friable; neutral; clear smooth boundary.

B1—7 to 13 inches; yellowish brown (10YR 5/4) light silty clay loam, dark brownish gray (10YR 6/2) dry; few fine prominent yellowish red (5YR 4/6) mottles; dark grayish brown (10YR 4/2) coatings on peds; moderate very fine subangular blocky structure; firm; some light gray (10YR 7/2) silt coatings; slightly acid; gradual smooth boundary.

B21t—13 to 21 inches; mottled yellowish brown (10YR 5/6) and yellowish red (5YR 4/6) heavy clay loam; faces of peds dark brown (7.5YR 3/2); moderate medium subangular blocky structure; firm; thick discontinuous clay films; a few black oxides; slightly acid; gradual smooth boundary.

B22t—21 to 28 inches; yellowish red (5YR 4/6) heavy clay loam; few medium distinct yellowish brown (10YR 5/6) and common fine distinct grayish brown (2.5Y 5/2) mottles; moderate medium subangular blocky structure; firm; thick discontinuous clay films; common black oxides; many pebbles; medium acid; gradual smooth boundary.

B23t—28 to 38 inches; mottled yellowish brown (5YR 5/6) and reddish yellow (7.5YR 6/6) heavy clay loam; common fine distinct grayish brown (2.5Y 5/2) mottles; moderate medium subangular blocky structure; firm; a few thick clay films; common black oxides; common pebbles; slightly acid; gradual smooth boundary.

B31t—38 to 47 inches; mottled yellowish red (5YR 5/6) and strong brown (7.5YR 5/6) heavy clay loam; weak coarse subangular blocky structure; firm; a few thick clay films; common black oxides; neutral; diffuse boundary.

B32—47 to 60 inches; mottled brownish yellow (10YR 6/6) and yellowish red (5YR 5/6) heavy clay loam; weak coarse subangular blocky structure; firm; common black oxides; a few pebbles and coarse sand grains; neutral.

The solum ranges from 40 to 60 inches in thickness.

The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). Texture is silt loam, loam, or light clay loam. The Ap horizon is 6 to 10 inches thick and ranges from medium acid to neutral.

The B22t horizon ranges from grayish brown (2.5Y 5/2) to yellowish red (5YR 4/6). Texture is heavy clay loam, clay, or silty clay. The B22t horizon is 6 to 10 inches thick and ranges from strongly acid to slightly acid.

The B3 horizon is medium or heavy clay loam. It is 8 to 20 inches thick and is medium acid to neutral.

Nevin series

The Nevin series consists of somewhat poorly drained, moderately permeable soils. These soils are on low second bottoms along the major streams. Nevin soils formed in alluvium under prairie grasses. Slope ranges from 0 to 2 percent.

These soils are outside the defined range of the Nevin series because they are too fine in texture. This difference does not alter their use and behavior.

Typical pedon of Nevin silty clay loam, 0 to 2 percent slopes, on a low bench in a cultivated field, 160 feet south and 960 feet east of the northwest corner of the SE1/4 sec. 1, T. 77 N., R. 19 W.:

Ap—0 to 9 inches; black (10YR 2/1) light silty clay loam, dark gray (10YR 4/1) dry; very dark brown (10YR 2/2) coatings on peds; weak fine granular structure; friable; medium acid; clear smooth boundary.

A12—9 to 14 inches; very dark brown (10YR 2/2) light silty clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; slightly acid; clear gradual boundary.

A3—14 to 20 inches; very dark grayish brown (10YR 3/2) light silty clay loam, grayish brown (10YR 5/2) dry; faces of peds very dark brown (10YR 2/2); weak very fine subangular blocky structure; friable; slightly acid; clear gradual boundary.

B1—20 to 26 inches; dark grayish brown (10YR 4/2) light silty clay loam, light gray (10YR 6/1) dry; faces of peds very dark grayish brown (10YR 3/2); weak very fine subangular blocky structure; friable; slightly acid; clear gradual boundary.

B21t—26 to 37 inches; mottled dark gray (10YR 4/1) and dark yellowish brown (10YR 4/4) heavy silty clay loam; faces of peds dark grayish brown (10YR 4/2); weak medium prismatic structure parting to weak fine subangular blocky; firm; thin discontinuous clay films; slightly acid; clear gradual boundary.

B22t—37 to 43 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak medium prismatic structure parting to weak fine subangular blocky; firm; thin discontinuous clay films; slightly acid; diffuse boundary.

B3—43 to 62 inches; light brownish gray (2.5Y 6/2) silty clay loam; common medium distinct brown (7.5YR 4/4) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; common soft black oxides; slightly acid.

The solum ranges from 36 to 62 inches in thickness. The A1 horizon is black (10YR 2/1), very dark brown (10YR 2/2), or very dark gray (10YR 3/1). Texture is light silty clay loam or heavy silt loam. The A1 horizon is 12 to 22 inches thick.

The B2t horizon ranges from dark gray (10YR 4/1) to grayish brown (2.5Y 5/2) with mottles of higher chroma. Texture is light to heavy silty clay loam. The B2t horizon is 10 to 17 inches thick and ranges from medium acid to slightly acid.

Nira series

The Nira series consists of moderately well drained, moderately permeable soils. These soils are on short convex side slopes which have many small waterways draining broad uplands. Nira soils formed in deoxidized loess under prairie grasses. Slope ranges from 2 to 9 percent.

Typical pedon of Nira silty clay loam, 2 to 5 percent slopes, on the shoulder of a divide in a cultivated field, 900 feet east and 44 feet north of the southwest corner of the NW1/4 sec. 25, T. 75 N., R. 19 W.:

Ap—0 to 7 inches; very dark gray (10YR 3/1) light silty clay loam, dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure parting to weak very fine granular; very friable; neutral; abrupt smooth boundary.

A3—7 to 12 inches; black (10YR 2/1) and very dark gray (10YR 3/1) heavy silty clay loam, very dark gray (10YR 3/1) and dark gray (10YR 4/1) dry; brown (10YR 4/3) in some crushed peds; weak fine subangular blocky structure; very friable; neutral; clear smooth boundary.

B21t—12 to 18 inches; dark brown (10YR 4/3) heavy silty clay loam, brown (10YR 5/3) dry; common very fine distinct grayish brown (2.5Y 5/2) mottles; faces of some peds very dark gray (10YR 3/1); moderate fine subangular blocky structure; friable; few thin discontinuous clay films; neutral; clear smooth boundary.

B22t—18 to 24 inches; dark brown (10YR 4/3) and grayish brown (2.5Y 5/2) silty clay loam; common coarse distinct strong brown (7.5YR 5/6 and 5/8) mottles; moderate fine and medium subangular blocky structure; friable; few thin discontinuous clay films; slightly acid; clear smooth boundary.

B31t—24 to 29 inches; grayish brown (2.5Y 5/2) and strong brown (7.5YR 5/6) silty clay loam; common coarse distinct reddish brown (5YR 4/4) mottles; moderate medium prismatic structure parting to moderate coarse subangular blocky; friable; thin clay films on faces of prisms; few fine distinct black iron-manganese oxides; slightly acid; abrupt smooth boundary.

B32t—29 to 36 inches; grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) light silty clay loam; few very coarse prominent strong brown (7.5YR 5/8) mottles; weak coarse subangular blocky structure; friable; thin clay films on faces of peds; neutral; gradual smooth boundary.

C11—36 to 52 inches; olive gray (5Y 5/2) and light olive gray (5Y 6/2) light silty clay loam; few fine prominent strong brown (7.5YR 5/8) mottles; few dark grayish brown (2.5Y 4/2) and grayish brown (2.5Y 5/2) coatings on vertical faces; some vertical cleavage; friable; neutral; gradual smooth boundary.

C12—52 to 60 inches; light olive gray (5Y 6/2) silt loam; common coarse prominent strong brown (7.5YR 5/6 and 5/8) and common medium prominent dark reddish gray (10YR 3/1) mottles; massive; friable; neutral.

The solum ranges from 30 to 50 inches in thickness.

The Ap horizon is very dark gray (10YR 3/1) or black (10YR 2/1). Texture is light or medium silty clay loam. The Ap horizon is 7 to 9 inches thick and is slightly acid or neutral.

The B22t horizon ranges from dark brown (10YR 4/3) to mottled grayish brown (2.5Y 5/2) and dark brown (10YR 4/3) with strong brown and reddish brown mottles. Texture is medium or heavy silty clay loam. The Ap horizon is 4 to 8 inches thick and medium or slightly acid.

The C horizon ranges from medium acid to neutral.

Nodaway series

The Nodaway series consists of moderately well drained, moderately permeable soils. These soils are on flood plains near the main stream channel. Nodaway soils formed in recent medium textured alluvium under mixed prairie grasses and forest. Slope ranges from 0 to 5 percent.

Typical pedon of Nodaway silt loam, 0 to 2 percent slopes, on bottom land in a cultivated field, 800 feet west and 400 feet south of the northwest corner of sec. 33, T. 76 N., R. 18 W.:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) and some pale brown (10YR 6/3) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

C1—8 to 50 inches; stratified brown (10YR 5/3) and very dark grayish brown (10YR 3/2) silt loam; few medium distinct reddish brown (5YR 4/4) mottles; massive but tending to platy because of stratification; friable; neutral; clear smooth boundary.

C2—50 to 60 inches; stratified very dark grayish brown (10YR 3/2) and pale brown (10YR 6/3) silt loam and fine sandy loam; massive but tending to platy because of stratification; friable; neutral.

The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). It is 6 to 10 inches thick and is slightly acid to neutral.

The C horizon mainly has value of 4 to 6 and chroma of 2 to 4 but the horizon includes very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) strata. Nodaway soils are sandy below a depth of 40 inches in some pedons.

Olmitz series

The Olmitz series consists of moderately well drained and well drained, moderately permeable soils. These soils are on slightly concave low foot slopes and alluvial fans that are downslope from moderately steep and steep clay loam till soils. Olmitz soils formed in local alluvium under prairie grasses. Slope ranges from 2 to 9 percent.

Typical pedon of Olmitz loam, 5 to 9 percent slopes, on a foot slope in a cultivated field, 225 feet east of the southwest corner of sec. 7, T. 77 N., R. 18 W.:

Ap—0 to 8 inches; black (10YR 2/1) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

A12—8 to 21 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; black (10YR 2/1) coatings on peds; weak fine subangular blocky structure parting to moderate fine and medium granular; friable; discontinuous gray silt coatings; neutral; diffuse boundary.

B1—21 to 27 inches; very dark grayish brown (10YR 3/2) light clay loam, grayish brown (10YR 5/2) dry; faces of peds very dark gray (10YR 3/1); moderate fine and medium subangular blocky structure; friable; common roots above a depth of 25 inches; discontinuous gray silt coatings; slightly acid; gradual smooth boundary.

B21—27 to 39 inches; dark brown (10YR 3/3) light clay loam, brown (10YR 5/3) dry; faces of peds very dark grayish brown (10YR 3/2); moderate fine subangular blocky structure; friable; slightly acid; diffuse boundary.

B22—39 to 48 inches; dark brown (10YR 3/3) clay loam, pale brown (10YR 6/3) dry; faces of peds very dark grayish brown (10YR 3/2); kneaded color brown (10YR 4/3); moderate medium subangular blocky structure; friable; few roots above a depth of 55 inches; slightly acid; diffuse boundary.

B3g—48 to 58 inches; brown (10YR 4/3) light clay loam, light yellowish brown (10YR 6/4) dry; faces of peds dark brown (10YR 3/3); weak medium subangular blocky structure; friable; slightly acid; gradual smooth boundary.

The solum ranges from 40 to 60 inches in thickness.

The Ap horizon is black (10YR 2/1), very dark brown (10YR 2/2), or very dark gray (10YR 3/1). Texture is loam or light clay loam. The Ap horizon is 5 to 8 inches thick and ranges from strongly acid to neutral.

The B2 horizon is dark brown (10YR 3/3) or brown (10YR 4/3) light or medium clay loam. The B2 horizon is 6 to 24 inches thick and is slightly acid or medium acid.

The B3 horizon is brown (10YR 4/3) or dark brown (10YR 3/3). It is 17 to 30 inches thick and is slightly acid or neutral.

Otley series

The Otley series consists of moderately well drained, moderately permeable soils. These soils are on narrow ridgetops and on long slightly convex side slopes in gently rolling and rolling areas. Otley soils formed in moderately fine textured loess under prairie grasses. Slope ranges from 2 to 14 percent.

Typical pedon of Otley silty clay loam, 2 to 5 percent slopes, on an upland divide in a cultivated field, 200 feet south and 200 feet west of the northeast corner of the NW1/4NW1/4 sec. 5, T. 76 N., R. 18 W.:

Ap—0 to 7 inches; very dark brown (10YR 2/2) light silty clay loam, dark grayish brown (10YR 4/2) dry; weak very fine granular structure; friable; medium acid; abrupt smooth boundary.

A12—7 to 12 inches; very dark brown (10YR 2/2) light silty clay loam, dark grayish brown (10YR 4/2) dry; weak very fine granular structure; friable; medium acid; clear smooth boundary.

A3—12 to 20 inches; very dark grayish brown (10YR 3/2) silty clay loam, brown (10YR 5/3) dry; moderate medium granular structure parting to weak very fine subangular blocky; friable; medium acid; gradual smooth boundary.

B21t—20 to 26 inches; dark brown (10YR 3/3) or brown (10YR 4/3) heavy silty clay loam, brown (10YR 5/3) dry; moderate very fine subangular blocky structure; friable; thin continuous clay films; medium acid; gradual smooth boundary.

B22t—26 to 30 inches; brown (10YR 4/3) heavy silty clay loam; few fine faint grayish brown (2.5Y 5/2) mottles; faces of peds dark grayish brown (10YR 4/2); moderate fine subangular blocky structure; friable; thin continuous clay films; medium acid; clear smooth boundary.

B23t—30 to 39 inches; brown (10YR 4/3) silty clay loam; common fine faint olive gray (5Y 5/2) mottles; faces of peds dark grayish brown (10YR 4/2); weak medium prismatic structure parting to moderate medium subangular blocky; friable; thin discontinuous clay films; medium acid; gradual smooth boundary.

B3—39 to 46 inches; olive gray (5Y 5/2) light silty clay loam; common fine distinct strong brown (7.5YR 5/8) mottles; faces of peds dark grayish brown (10YR 4/2); weak medium prismatic structure parting to moderate medium subangular blocky; friable; thin discontinuous clay films; medium acid; diffuse boundary.

C1—46 to 57 inches; olive (5Y 5/3) light silty clay loam; many medium prominent strong brown (7.5YR 5/6) mottles; massive; friable; roots penetrate to a depth of 52 inches; neutral; diffuse boundary.

C2—57 to 62 inches; olive gray (5Y 5/2) light silty clay loam; strong brown (7.5YR 5/6) bands of iron; massive; friable; neutral.

The solum ranges from 45 to 72 inches in thickness. The A horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2). It is 10 to 20 inches thick and is medium acid or slightly acid.

The B22t horizon ranges from brown (10YR 4/3) to yellowish brown (10YR 5/4). Texture ranges from medium silty clay loam to light silty clay. The B22t horizon is 4 to 10 inches thick and is strongly acid or medium acid.

The C horizon ranges from olive gray (5Y 5/2) to yellowish brown (10YR 5/4). Texture is light silty clay loam or heavy silt loam.

Pershing series

The Pershing series consists of moderately well drained and somewhat poorly drained, slowly permeable soils. These soils are on side slopes and ridgetops of upland divides and on benches adjacent to major streams. Pershing soils formed in moderately fine textured and fine textured loess under mixed prairie grasses and trees. Slope ranges from 2 to 9 percent.

Typical pedon of Pershing silt loam, 2 to 5 percent slopes, on the shoulder of an upland divide in a cultivated field, 300 feet west and 300 feet north of the southeast corner of SE1/4NE1/4 sec. 22, T. 74 N., R. 19 W.:

Ap—0 to 7 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; friable; slightly acid; abrupt smooth boundary.

A2—7 to 9 inches; dark grayish brown (10YR 4/2) silt loam; weak thick platy structure parting to moderate very fine subangular blocky; friable; many silt coatings that are white (10YR 8/1) when dry; medium acid; abrupt smooth boundary.

B1—9 to 14 inches; dark grayish brown (2.5Y 4/2) and grayish brown (2.5Y 5/2) light silty clay loam; moderate very fine subangular blocky and angular blocky structure; friable; many silt coatings that are white (10YR 8/1) when dry; medium acid; clear smooth boundary.

B21t—14 to 20 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine distinct yellowish brown (10YR 5/8) mottles; strong fine angular blocky and subangular blocky structure; firm; thin discontinuous clay films; common silt coatings that are white (10YR 8/1) when dry; medium acid; gradual smooth boundary.

B22t—20 to 32 inches; grayish brown (2.5Y 5/2) light silty clay; common medium distinct strong brown (7.5YR 5/8) mottles; faces of peds very dark gray (10YR 3/1); moderate fine and medium subangular

blocky structure; firm; thin discontinuous clay films; strongly acid; gradual smooth boundary.

B23t—32 to 38 inches; grayish brown (2.5Y 5/2) heavy silty clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; thin discontinuous clay films; common fine black oxides; medium acid; gradual smooth boundary.

B31t—38 to 50 inches; light brownish gray (2.5Y 6/2) silty clay loam; common medium distinct strong brown (7.5Y 5/6) mottles; weak coarse subangular blocky structure; firm; clay fills in root channels; slightly acid; diffuse boundary.

B32t—50 to 60 inches; light brownish gray (2.5Y 6/2) light silty clay loam; common medium distinct strong brown (7.5YR 5/6) mottles; weak coarse subangular blocky structure; friable; clay balls; neutral.

The solum is 6 feet or more thick.

The Ap horizon is medium or heavy silt loam. It is 7 to 10 inches thick and is slightly acid or neutral.

The A2 horizon is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2) light or medium silt loam. The A2 horizon is 0 to 6 inches thick and is medium acid or slightly acid.

The B22t horizon is grayish brown (2.5Y 5.2) or brown (10YR 4/3) with gray and grayish brown mottles. Texture is light or medium silty clay. The B22t horizon is 8 to 12 inches thick and is strongly acid or medium acid.

The B32t horizon ranges from gray (5Y 6/1) to light brownish gray (2.5Y 6/2). Mottles range from olive brown to yellowish brown. Texture is medium or light silty clay loam. The B32t horizon is 8 to 16 inches thick and is medium acid to neutral.

In map unit 131C2, the dark colored material is not thick enough for the soil to be an Udollic intergrade.

Sharpsburg series

The Sharpsburg series consists of moderately well drained, moderately permeable soils. These soils are on narrow ridgetops and on rather long, slightly convex side slopes in gently rolling and rolling areas. Sharpsburg soils formed in moderately fine textured loess under prairie grasses. Slope ranges from 2 to 14 percent.

Typical pedon of Sharpsburg silty clay loam, 2 to 5 percent slopes, on an upland divide in a cultivated field, 140 feet west and 300 feet north of the southeast corner of the NW1/4SE1/4 sec. 19, T. 76 N., R. 21 W.:

Ap—0 to 9 inches; very dark gray (10YR 3/1) silty clay loam, grayish brown (10YR 5/2) dry; black (10YR 2/1) coatings on peds; cloddy parting to weak fine and medium granular structure; friable; medium acid; gradual smooth boundary.

A12—9 to 14 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; faces of peds very dark gray (10YR 3/1); moderate very fine subangular blocky structure; friable; neutral; gradual smooth boundary.

A3—14 to 17 inches; dark brown (10YR 3/3) heavy silty clay loam, grayish brown (10YR 5/2) dry; faces of peds very dark grayish brown (10YR 3/2); moderate very fine subangular blocky structure; friable; neutral; gradual smooth boundary.

B21t—17 to 23 inches; brown (10YR 4/3) heavy silty clay loam, light grayish brown (10YR 6/2) dry; faces of peds very dark grayish brown (10YR 3/2) and dark brown (10YR 4/3); weak medium subangular blocky structure parting to moderate very fine subangular blocky; friable; thin discontinuous clay films; neutral; gradual smooth boundary.

B22t—23 to 28 inches; brown (10YR 4/3) heavy silty clay loam; faces of peds dark grayish brown (10YR 4/2); weak medium prismatic structure parting to moderate fine subangular blocky; firm; thin discontinuous clay films; medium acid; gradual smooth boundary.

B23t—28 to 33 inches; brown (10YR 4/3) silty clay loam; common fine distinct light brownish gray (2.5Y 6/2) mottles; weak medium prismatic structure parting to weak moderate subangular blocky; friable; thin and thick discontinuous clay films; medium acid; gradual smooth boundary.

B31t—33 to 40 inches; brown (10YR 4/3) silty clay loam; common fine distinct light brownish gray (2.5Y 6/2) and few fine distinct strong (7.5YR 5/8) mottles; weak medium prismatic structure; friable; common roots above a depth of 36 inches; thick discontinuous clay films; few fine soft black oxides; medium acid; diffuse boundary.

B32t—40 to 56 inches; yellowish brown (10YR 5/4) light silty clay loam; common fine distinct yellowish brown (10YR 5/8) and common medium distinct light olive gray (5Y 6/2) mottles; weak coarse prismatic structure; friable; thin discontinuous clay films; neutral; diffuse boundary.

C—56 to 69 inches; light brownish gray (2.5Y 6/2) heavy silt loam; common medium distinct strong brown (7.5YR 5/8) mottles; massive; friable; a few roots above a depth of 60 inches; common fine tubular pores; neutral.

The solum is typically 48 inches or more thick.

The Ap horizon ranges from very dark brown (10YR 2/2) to very dark gray (10YR 3/1). Texture is light or medium silty clay loam. The Ap horizon is 6 to 9 inches thick and is medium acid or slightly acid.

The A12 horizon is very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2) is light or medium silty clay loam. The A12 horizon is 3 to 5 inches thick and ranges from medium acid to neutral.

The B22t horizon is brown (10YR 4/3) or dark yellowish brown (10YR 4/4) heavy silty clay loam or light silty

clay. The B22t horizon is 5 to 8 inches thick and is strongly acid or medium acid.

The C horizon is grayish brown (2.5Y 5/2) or light brownish gray (2.5Y 6/2) light silty clay loam or heavy silt loam. It is slightly acid or neutral.

Shelby series

The Shelby series consists of moderately well drained, moderately slowly permeable soils. These soils are on the lower part of upland side slopes and on some low, narrow ridgetops in rather strongly dissected uplands. Shelby soils formed in clay loam glacial till under native prairie. Slope ranges from 9 to 18 percent.

Typical pedon of Shelby loam, 9 to 14 percent slopes, moderately eroded, on an upland side slope in permanent pasture, 200 feet north and 800 feet west of the southeast corner of sec. 20, T. 77 N., R. 18 W.:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) and 10 percent brown (10YR 4/3) heavy loam, dark brown (10YR 3/3) dry; faces of peds very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2); weak fine subangular blocky structure; friable; few pebbles; neutral; clear smooth boundary.

B1—8 to 11 inches; dark brown (10YR 3/3) and 20 percent brown (10YR 4/3) loam, very dark grayish brown (10YR 3/2) kneaded, dark grayish brown (10YR 4/2) dry; faces of peds very dark grayish brown (10YR 3/2); weak fine subangular blocky structure; friable; few pebbles; neutral; clear smooth boundary.

B21t—11 to 21 inches; brown (10YR 4/3) light clay loam; few fine distinct strong brown (7.5YR 5/8) mottles; faces of peds dark brown (10YR 3/3); moderate fine and very fine subangular blocky structure; friable; thin discontinuous clay films; common pebbles; medium acid; diffuse boundary.

B22t—21 to 33 inches; yellowish brown (10YR 5/4) light clay loam; moderate medium subangular blocky structure; firm; thin discontinuous clay films; common pebbles; medium acid; diffuse boundary.

B3t—33 to 42 inches; yellowish brown (10YR 5/4) clay loam; few fine distinct light brownish gray (10YR 6/2) and few medium distinct yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; firm; thin discontinous clay films; few pebbles; medium acid; diffuse boundary.

C—42 to 60 inches; yellowish brown (10YR 5/4 and 5/6) heavy loam; massive; firm; few pebbles; medium acid.

Solum thickness is typically 40 to 50 inches but ranges from 30 to 75 inches.

The Ap horizon range from very dark brown (10YR 2/2) to very dark grayish brown (10YR 3/2). Texture is generally loam but in places is light clay loam or silt loam. The Ap horizon is neutral to medium acid.

The B2t horizon ranges from brown (10YR 4/3) to yellowish brown (10YR 5/6). Texture is typically light clay loam with thin layers of medium or heavy clay loam in places. The B2t horizon is 10 to 24 inches thick and is strongly acid or medium acid.

The C horizon ranges from grayish brown (2.5Y 5/2) to yellowish brown (10YR 5/6) with common or many mottles ranging from dark yellowish brown (10YR 4/4) to strong brown (7.5YR 5/6). Texture is loam or light clay loam.

Spillville series

The Spillville series consists of moderately well drained and somewhat poorly drained, moderately permeable soils. These soils are on wide bottom lands. Spillville soils formed in loamy alluvium under prairie grasses. Slope ranges from 0 to 2 percent.

Typical pedon of Spillville loam, 0 to 2 percent slopes, on a low bench in a cultivated field, 60 feet east and 240 feet south of the northwest corner of the SE1/4SW1/4 sec. 20, T. 76 N., R. 18 W.:

Ap—0 to 8 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; black (10YR 2/1) coatings on peds; cloddy parting to weak fine granular structure; friable; neutral; clear smooth boundary.

A12—8 to 25 inches; black (10YR 2/1) loam, very dark grayish brown (10YR 3/2) dry; weak medium subangular blocky structure parting to moderate fine granular; friable; neutral; diffuse boundary.

A13—25 to 36 inches; very dark gray (10YR 3/1) heavy silt loam, dark grayish brown (10YR 4/2) dry; faces of peds black (10YR 2/1); weak medium and fine subangular blocky structure; friable; neutral; diffuse boundary.

A3—36 to 46 inches; very dark grayish brown (10YR 3/2) loam that is high in silt, grayish brown (10YR 5/2) dry; faces of peds very dark gray (10YR 3/1); weak medium subangular blocky structure; friable; neutral; diffuse boundary.

C—46 to 60 inches; dark grayish brown (10YR 4/2) loam that is high in silt; massive; friable; neutral.

Solum thickness is typically 40 inches but ranges from 30 to 56 inches.

The Ap horizon is black (10YR 2/1) or very dark brown (10YR 2/2). It is 8 to 10 inches thick and is slightly acid or neutral.

The A13 horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). It is 10 to 20 inches thick and is slightly acid or neutral.

The C horizon is very dark grayish brown (10YR 3/2) or dark grayish brown (10YR 4/2). It is slightly acid or neutral.

Taintor series

The Taintor series consists of poorly drained, moderately slowly permeable soils. These soils are on broad upland divides. Taintor soils formed in moderate fine textured or medium textured loess under prairie grasses tolerant of wetness. Slope ranges from 0 to 2 percent.

Typical pedon of Taintor silty clay loam, 0 to 2 percent slopes, on a broad upland divide in a cultivated field, 420 feet west and 300 feet south of the northeast corner of the NW1/4NW1/4 sec. 5, T. 77 N., R. 19 W.:

Ap—0 to 9 inches; black (10YR 2/1) light silty clay loam, dark gray (10YR 4/1) dry; cloddy parting to weak fine granular structure; friable; neutral; clear smooth boundary.

A12—9 to 19 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; black (10YR 2/1) coatings on peds; moderate fine and medium granular structure; friable; slightly acid; clear smooth boundary.

B1g—19 to 23 inches; very dark gray (10YR 3/1) and dark gray (10YR 4/1) heavy silty clay loam, light gray (10YR 6/1) dry; few fine distinct yellowish brown (10YR 5/6) mottles; faces of peds very dark gray (10YR 3/1); moderate very fine subangular blocky structure; firm; slightly acid; gradual smooth boundary.

B21tg—23 to 31 inches; grayish brown (2.5Y 5/2) heavy silty clay loam; common fine distinct yellowish brown (10YR 5/8) mottles; faces of peds dark gray (10YR 4/1); moderate medium prismatic structure parting to moderate medium and fine subangular blocky; firm; thin discontinuous clay films; common fine soft strong brown oxides; slightly acid; gradual smooth boundary.

B22tg—31 to 39 inches; grayish brown (2.5Y 5/2) heavy silty clay loam; common fine distinct yellowish brown (10YR 5/6) and few medium distinct strong brown (7.5YR 5/8) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; patchy thin very dark gray (10YR 3/1) clay films on vertical faces; few fine soft black oxides; neutral; gradual smooth boundary.

B31tg—39 to 48 inches; mottled light olive gray (5Y 6/2) and strong brown (7.5YR 5/8) silty clay loam; weak medium prismatic structure; friable; common very dark gray (10YR 3/1) clay films and organic coats on vertical faces; neutral; diffuse boundary.

B32tg—48 to 60 inches; light gray (5Y 6/1) light silty clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure; friable; thin discontinuous very dark gray (10YR 3/1) clay films and organic coatings on vertical cleavage faces; neutral; diffuse boundary.

Cg—60 to 67 inches; light gray (5Y 6/1) silt loam; common fine distinct yellowish brown (10YR 5/6) mottles; massive; friable; neutral.

The solum ranges from 42 to 72 inches in thickness. The A1 horizon is black (N 2/0 or 10YR 2/1) or very dark brown (10YR 2/2). Texture ranges from light to heavy silty clay loam. The A1 horizon is 10 to 19 inches thick and is slightly acid or neutral.

The B2tg horizon ranges from dark gray (10YR 4/1) to olive gray (5Y 5/2). Texture ranges from medium silty clay loam to light silty clay. The B2tg horizon is 12 to 20 inches thick and is slightly acid or neutral.

The Cg horizon ranges from olive gray (5Y 5/2) to light gray (5Y 6/1). Texture is light silty clay loam or heavy silt loam.

Tallula series

The Tallula series consists of well drained, moderately permeable soils. These strongly sloping to steep soils are on ridgetops and side slopes on uplands. Tallula soils formed in loess under mixed prairie grasses and trees. Slope ranges from 12 to 20 percent.

Typical pedon of Tallula silt loam in an area of Tallula-Downs silt loams, 12 to 20 percent slopes, in pasture, 300 feet south and 400 feet west of the northeast corner of the NW1/4 sec. 1, T. 77 N., R. 18 W.:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; friable; neutral; clear smooth boundary.

A3—9 to 13 inches; very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate medium subangular blocky structure parting to moderate very fine subangular blocky; friable; neutral; gradual smooth boundary.

B2—13 to 20 inches; brown (10YR4/3) silt loam; dark brown (10YR 3/3) coatings on peds; moderate fine subangular blocky structure; friable; mildly alkaline; gradual smooth boundary.

B3—20 to 23 inches; brown (10YR 5/3) and yellowish brown (10YR 5/4) silt loam; weak moderate subangular blocky structure; friable; mildly alkaline; gradual smooth boundary.

C1—23 to 31 inches; light yellowish brown (10YR 6/4) light silt loam; few fine distinct light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/8) mottles; massive; friable; common roots; calcareous; diffuse boundary.

C2—31 to 60 inches; mottled light yellowish brown (10YR 6/4) and grayish brown (2.5Y 5/2) light silt loam; massive; friable; common pores; calcareous.

The solum ranges from 18 to 35 inches in thickness.

The A1 horizon ranges from very dark brown (10YR 2/2) to dark brown (10YR 3/3). It is 7 to 15 inches thick and is neutral to mildly alkaline.

The B2 horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. Texture is medium to heavy silt loam. The B2 horizon is 5 to 10 inches thick and is neutral to mildly alkaline in reaction.

The C horizon is yellowish brown (10YR 5/6) to light yellowish brown (10YR 6/4). Texture is silt or silt loam.

Tama series

The Tama series consists of well drained, moderately permeable soils. These soils are on narrow ridgetops and convex side slopes. Tama soils are formed in moderately fine textured or medium textured loess under native prairie. Slope ranges from 2 to 14 percent.

Typical pedon of Tama silty clay loam, 2 to 5 percent slopes, on an upland divide in a cultivated field, 400 feet west and 600 feet south of the northeast corner of the SE1/4SW1/4 sec. 16, T. 77 N., R. 18 W.:

Ap—0 to 8 inches; very dark brown (10YR 2/2) light silty clay loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; silghtly acid; clear smooth boundary.

A12—8 to 13 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; very dark brown (10YR 2/2) coatings on peds; moderate fine granular structure; friable; slightly acid; clear smooth boundary.

A3—13 to 17 inches; dark brown (10YR 3/3) silty clay loam, pale brown (10YR 6/3) dry; faces of peds very dark grayish brown (10YR 3/2); moderate very fine subangular blocky structure; friable; medium acid; gradual smooth boundary.

B1—17 to 21 inches; brown (10YR 4/3) silty clay loam; faces of peds very dark grayish brown (10YR 3/2) and some dark brown (10YR 3/3); moderate very fine subangular blocky structure; friable; common roots above a depth of 19 inches; medium acid; gradual smooth boundary.

B21t—21 to 27 inches; dark yellowish brown (10YR 4/4) silty clay loam; some faces of peds dark brown (10YR 3/3); moderate medium subangular blocky structure; friable; thin and thick discontinuous clay films; slightly acid; gradual smooth boundary.

B22t—27 to 33 inches; dark yellowish brown (10YR 4/4) or yellowish brown (10YR 5/4) silty clay loam; faces of peds brown (10YR 4/3); moderate medium subangular blocky structure; friable; thin patchy discontinuous clay films; discontinuous gray silt coatings; slightly acid; gradual smooth boundary.

B3—33 to 43 inches; dark yellowish brown (10YR 4/4) silty clay loam; common fine distinct yellowish brown (10YR 5/6) and light brownish gray (2.5Y 6/2) mottles; weak medium prismatic structure parting to weak medium and coarse subangular blocky; friable; discontinuous gray silt coatings; a few roots above a depth of 40 inches; slightly acid; diffuse boundary.

C—43 to 72 inches; yellowish brown (10YR 5/4) light silty clay loam; common medium distinct yellowish brown (10YR 5/6) and light brownish gray (2.5Y 6/2) mottles; massive; some vertical cleavage; friable; common, tubular pores; a few dark oxides; slightly acid.

The solum ranges from 36 to 60 inches in thickness.

The A1 horizon is black (10YR 2/1) or very dark grayish brown (10YR 3/2) light silty clay loam or silt loam. The A1 horizon is 10 to 20 inches thick and ranges from strongly acid to slightly acid.

The B2t horizon is brown (10YR 4/3) or dark yellowish brown (10YR 4/4) light or medium silty clay loam. The B2t horizon is 8 to 20 inches thick and ranges from strongly acid to slightly acid.

The C horizon ranges from dark brown (10YR 4/3) to yellowish brown (10YR 5/6). It is medium acid or slightly acid.

Tuskeego series

The Tuskeego series consists of poorly drained, very slowly permeable soils. These soils are on nearly level, slightly concave first or second bottoms. Tuskeego soils formed in moderately fine textured alluvium under mixed prairie grasses and trees. Slope ranges from 0 to 2 percent.

Typical pedon of Tuskeego silt loam, 0 to 2 percent slopes, on cultivated bottom land, 345 feet west and 1,040 feet north of the southeast corner of sec. 1, T. 77 N., R. 19 W.:

Ap—0 to 7 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) heavy silt loam, dark gray (10YR 4/1) dry; faces of peds black (10YR 2/1); cloddy parting to weak fine granular structure; friable; medium acid; gradual smooth boundary.

A12—7 to 9 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) heavy silt loam; faces of peds black (10YR 2/1); weak thick platy structure parting to weak very fine granular; friable; medium acid; clear smooth boundary.

A21—9 to 15 inches; light brownish gray (10YR 6/2) and pale brown (10YR 6/3) silt loam; faces of peds dark gray (10YR 4/1) or dark grayish brown (10YR 4/2); moderate medium platy structure; friable; medium acid; clear smooth boundary.

A22—15 to 20 inches; light brownish gray (10YR 6/2) silt loam; faces of peds gray (10YR 5/1) or grayish brown (10YR 5/2); moderate medium platy structure; friable; few roots above a depth of 18 inches; slightly acid; clear smooth boundary.

B1g—20 to 24 inches; grayish brown (10YR 5/2) and grayish brown (2.5Y 5/2) light silty clay loam; common fine faint dark brown (7.5YR 3/2 and 4/4) mottles; faces of peds very dark gray (10YR 3/1); moderate medium subangular blocky structure; friable; slightly acid; clear smooth boundary.

B21tg—24 to 32 inches; dark gray (10YR 4/1) and grayish brown (10YR 5/2) silty clay loam; few common distinct strong brown (7.5YR 5/6) mottles; faces of peds very dark gray (10YR 3/1); weak medium prismatic structure parting to moderate medium subangular blocky; firm; patchy thin clay films; slightly acid; gradual smooth boundary.

B22tg—32 to 40 inches; dark gray (10YR 4/1) heavy silty clay loam; common medium distinct strong brown (7.5YR 5/6) and yellowish brown (10YR 5/6) mottles; faces of peds very dark gray (10YR 3/1); weak medium prismatic structure; firm; patchy thin clay films; neutral; gradual smooth boundary.

B3g—40 to 48 inches; gray (10YR 5/1) heavy silty clay loam; common medium distinct strong brown (7.5YR 5/6) and yellowish brown (10YR 5/6) mottles; faces of peds very dark gray (10YR 3/1); weak coarse subangular blocky structure; firm; few soft black concretions; neutral; gradual smooth boundary.

Cg—48 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam; common medium distinct strong brown (7.5YR 5/8) and yellowish brown (10YR 5/8) mottles; massive; firm; neutral.

The solum ranges from 48 to 72 inches in thickness. The A1 horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) heavy silt loam or light silty clay loam. The A1 horizon is 7 to 9 inches thick. The A2 horizon ranges from dark gray (10YR 4/1) to light brownish gray (10YR 6/2). It is 6 to 14 inches thick and ranges from very strongly acid to slightly acid.

The B22tg horizon ranges from dark gray (10YR 4/1) to grayish brown (10YR 5/2). Texture ranges from heavy silty clay loam to medium silty clay. The B22tg horizon is 5 to 20 inches thick and ranges from strongly acid to neutral.

Vesser series

The Vesser series consists of somewhat poorly drained and poorly drained, moderately permeable soils. These soils are on low second bottoms along major streams and on narrow benches and gentle foot slopes along tributaries of major streams. Vesser soils formed in moderately fine textured alluvium under mixed prairie grasses and trees tolerant of wetness. Slope ranges from 0 to 5 percent.

Typical pedon of Vesser silt loam, 0 to 2 percent, on a low bench in a cultivated field, 660 feet east and 600 feet south of the northwest corner of the NE1/4NW1/4 sec. 27, T. 77 N., R. 20 W.:

Ap—0 to 7 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) light silt loam, dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) dry; weak fine and very fine subangular blocky structure; friable; neutral; clear smooth boundary.

A12—7 to 15 inches; very dark grayish brown (10YR 3/2) light silt loam, grayish brown (10YR 5/2) dry; faces of peds very dark gray (10YR 3/1); weak very thick platy structure parting to weak fine subangular blocky; friable; neutral; gradual smooth boundary.

A21—15 to 20 inches; dark gray (10YR 4/1) light silt loam, light brownish gray (10YR 6/2) dry; faces of peds very dark gray (10YR 3/1); weak thick platy structure parting to moderate very fine subangular blocky; friable; common roots above a depth of 18 inches; slightly acid; gradual smooth boundary.

A22—20 to 27 inches; dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) light silt loam; weak thick platy structure parting to moderate fine and very fine subangular blocky structure; friable; medium acid; gradual smooth boundary.

A23—27 to 34 inches; grayish brown (10YR 5/2) silt loam; weak fine and very fine subangular blocky structure; friable; strongly acid; gradual smooth boundary.

B21tg—34 to 42 inches; dark grayish brown (10YR 4/2) light silty clay loam; faces of peds very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2); weak medium prismatic structure parting to moderate medium subangular blocky; firm; few roots above a depth of 40 inches; thin discontinuous clay films; strongly acid; clear smooth boundary.

B22tg—42 to 54 inches; dark grayish brown (10YR 4/2) and some very dark grayish brown (10YR 3/2) silty clay loam; faces of peds very dark gray (10YR 3/1); weak medium prismatic structure parting to moderate medium subangular blocky; firm; thin discontinuous clay films; medium acid; gradual smooth boundary.

B23tg—54 to 60 inches; dark grayish brown (10YR 4/2) light silty clay loam; faces of peds very dark gray (10YR 3/1); weak medium prismatic structure parting to moderate medium subangular blocky; firm; few fine tubular pores; thin discontinuous clay films; medium acid; gradual smooth boundary.

B3tg—60 to 70 inches; dark gray (10YR 4/1) light silty clay loam; common fine distinct dark grayish brown (2.5Y 4/2) and olive brown (2.5Y 4/4); mottles; faces of peds very dark grayish brown (2.5Y 3/2); weak medium prismatic structure; firm; thin discontinuous clay films; medium acid.

The solum is more than 60 inches thick in many places.

The A1 horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2). Texture is silt loam or

light silty clay loam. The A1 horizon is 12 to 20 inches thick and is slightly acid or neutral.

The A2 horizon ranges from dark gray (10YR 4/1) to grayish brown (10YR 5/2). Texture ranges from light to heavy silt loam. The A2 horizon is 12 to 20 inches thick and ranges from strongly acid to slightly acid.

The B2t horizon is dark gray (10YR 4/1) or dark grayish brown (10YR 4/2). Texture ranges from light to heavy silty clay loam. The B2t horizon is 15 to 26 inches thick and is strongly acid or medium acid.

Wabash series

The Wabash series consists of very poorly drained, very slowly permeable soils. These soils are on wide bottom lands. Wabash soils formed in fine textured alluvium under prairie grasses tolerant of excessive wetness. Slope ranges from 0 to 2 percent.

Typical pedon of Wabash silty clay loam, 0 to 2 percent slopes, on bottom land in meadow, 66 feet east and 210 feet north of the southwest corner of the NE1/4NE1/4 sec. 16, T. 74 N., R. 18 W.

Ap—0 to 6 inches; black (10YR 2/1) light silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

A12—6 to 19 inches; black (N 2/0) heavy silty clay, very dark gray (10YR 3/1) dry; moderate medium granular structure; firm; neutral; diffuse boundary.

A3—19 to 24 inches; black (N 2/0) heavy silty clay; strong very fine subangular blocky structure; very firm; neutral; diffuse boundary.

B1g—24 to 38 inches; very dark gray (N 3/0) heavy silty clay; weak medium subangular blocky structure parting to moderate very fine subangular blocky; extremely firm; few roots above a depth of 30 inches; neutral; diffuse boundary.

B2g—38 to 50 inches; very dark gray (10YR 3/1) heavy silty clay; few fine faint olive (5Y 5/3) mottles; weak medium subangular blocky structure parting to moderate very fine subangular blocky; extremely firm; neutral; diffuse boundary.

Cg—50 to 60 inches; dark gray (10YR 4/1) heavy silty clay; common fine distinct yellowish brown (10YR 5/6) mottles; massive; very firm; neutral.

The solum ranges from 40 to 60 inches in thickness. The A1 horizon has hue of 10YR to 5Y or neutral, value of 2 or 3, and chroma of 2 or less. Texture ranges from silty clay loam to silty clay. The A1 horizon ranges from medium acid to neutral.

The B1g horizon has hue of 10YR to 5Y or is neutral and has value of 2 or 3 and chroma of 2 or less. The B1g horizon is 12 to 19 inches thick and is neutral or slightly acid.

The B2g horizon has hue of 10YR to 5Y or neutral and value of 3 to 5; it has mottles 10YR or yellower in hue and higher in chroma. The B2g horizon is 8 to 14 inches thick and is slightly acid or neutral.

Weller series

The Weller series consists of moderately well drained, slowly permeable soils. These soils are on ridgetops and convex side slopes in highly dissected areas. Weller soils formed in loess under forest. Slope ranges from 2 to 9 percent.

Typical pedon of Weller silt loam, 2 to 5 percent slopes, on a narrow upland divide in a cultivated field, 230 feet north and 120 feet east of the southwest corner of the NW1/4SW1/4 sec. 33, T. 74 N., R. 18 W.:

Ap—0 to 8 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; cloddy parting to weak thick platy structure; friable; neutral; abrupt smooth boundary.

A2—8 to 10 inches; grayish brown (10YR 5/2) and pale brown (10YR 6/3) silt loam, light gray (10YR 7/2) dry; weak thick platy structure parting to moderate very fine subangular blocky; friable; medium acid; clear smooth boundary.

B1t—10 to 15 inches; brown (10YR 5/3) heavy silty clay loam, light brownish gray (10YR 6/2) dry; few fine distinct brown (7.5YR 4/4) mottles; faces of peds dark grayish brown (10YR 4/2); moderate fine subangular blocky and angular blocky structure; firm; thin continuous clay films; strongly acid; gradual smooth boundary.

B21t—15 to 26 inches; mottled grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) silty clay; faces of peds dark grayish brown (10YR 4/2); moderate medium subangular blocky and angular blocky structure; firm; thin continuous clay films; strongly acid; diffuse boundary.

B22t—26 to 36 inches; grayish brown (2.5Y 5/2) heavy silty clay loam; common medium distinct strong brown (7.5YR 5/6) mottles; faces of peds dark grayish brown (10YR 4/2); moderate medium subangular blocky and angular blocky structure; firm; thin continuous clay films; common soft black oxides; strongly acid; diffuse boundary.

B31t—36 to 46 inches; light brownish gray (2.5Y 6/2) heavy silty clay loam; common medium distinct strong brown (7.5YR 5/6) mottles; faces of peds dark grayish brown (10YR 4/2); weak medium subangular blocky structure; firm; common roots above a depth of 42 inches; thin discontinuous clay films; few soft black oxides; strongly acid; diffuse boundary.

B32t—46 to 55 inches; light olive gray (5Y 6/2) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; faces of peds dark grayish

brown (10YR 4/2); weak coarse subangular blocky structure; firm; thin discontinuous clay films; few soft black oxides; strongly acid; diffuse boundary.

C—55 to 60 inches; light olive gray (5Y 6/2) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; massive; medium acid.

The Ap horizon is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2) medium or heavy silt loam. The Ap horizon is 4 to 8 inches thick and ranges from strongly acid to neutral.

The A2 horizon ranges from grayish brown (10YR 4/2) to pale brown (10YR 6/3). Texture is light or medium silt loam. Where present, the A2 horizon is as much as 12 inches thick and ranges from very strongly acid to medium acid.

The B2t horizon is heavy silty clay loam to medium clay. The B2t horizon is 10 to 21 inches thick and is very strongly acid or strongly acid.

The B3t horizon ranges from light olive gray (5Y 6/2) to grayish brown (2.5Y 5/2) with yellowish brown and strong brown mottles.

Winterset series

The Winterset series consists of poorly drained, moderately slowly permeable soils. These soils are on broad uplands. Winterset soils formed in loess under prairie grasses tolerant of wetness. Slope ranges from 0 to 2 percent.

Typical pedon of Winterset silty clay loam, 0 to 2 percent slopes, on a broad upland divide in a cultivated field, 45 feet west and 491 feet north of the southeast corner of the SW1/4SE1/4 sec. 22, T. 76 N., R. 21 W.:

Ap—0 to 9 inches; black (N 2/0) light silty clay loam, gray (10YR 5/1) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

A12—9 to 16 inches; black (10YR 2/1) and very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; black (N 2/0) coatings on peds; moderate medium granular structure; friable; slightly acid; gradual smooth boundary.

B1g—16 to 20 inches; very dark gray (10YR 3/1) heavy silty clay loam, light gray (10YR 6/1) dry; common fine faint light grayish brown (7.5YR 4/2) mottles; faces of peds black (10YR 2/1); moderate very fine subangular blocky structure; firm; slightly acid; clear smooth boundary.

B21tg—20 to 26 inches; dark gray (5YR 4/1) light silty clay; common medium distinct yellowish brown (10YR 5/6) mottles; faces of peds black (10YR 2/1) and dark gray (10YR 3/1); moderate fine subangular blocky structure; firm; thin continuous clay films; medium acid; clear smooth boundary.

B22tg—26 to 31 inches; olive gray (5Y 5/2) light silty clay; common medium prominent reddish yellow (7.5YR 6/8) mottles; faces of peds very dark gray (10YR 3/1); weak medium prismatic structure parting to moderate medium subangular blocky; firm; thick continuous clay films; slightly acid; gradual boundary.

B23g—31 to 39 inches; olive gray (5Y 5/2) heavy silty clay loam; common medium prominent reddish yellow (7.5YR 6/8) and yellowish brown (10YR 5/8) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; medium acid; diffuse boundary.

B3g—39 to 48 inches; olive gray (5Y 5/2) silty clay loam; common medium prominent strong brown (7.5YR 5/8) mottles; faces of peds gray (10YR 5/1); weak medium prismatic structure parting to weak coarse subangular blocky; friable; medium acid; diffuse boundary.

C1g—48 to 63 inches; light olive gray (5Y 6/2) silty clay loam; few medium prominent strong brown (7.5YR 5/8) mottles; massive; friable; few roots above a depth of 55 inches; black (10YR 2/1) coatings on root channels; slightly acid; diffuse boundary.

C2g—63 to 87 inches; light olive gray (5Y 6/2) silty clay loam; many coarse distinct reddish yellow (5Y 6/8) mottles; massive; friable; few very dark gray (10YR 3/1) organic stains on root channels; few tubular pores; neutral.

The solum ranges from 48 to 72 inches in thickness.

The Ap horizon is black (10YR 2/1 or N 2/0). Texture ranges from heavy silt loam to medium silty clay loam. The Ap horizon is 6 to 9 inches thick and is slightly acid or neutral.

The A12 horizon is black (10YR 2/1) or very dark gray (10YR 3/1). Texture is light or medium silty clay loam. The A12 horizon is 7 to 12 inches thick and is medium acid or slightly acid.

The B22tg horizon ranges from dark grayish brown (10YR 4/2) to olive gray (5Y 5/2). Texture is heavy silty clay loam or light silty clay. The B22tg horizon is 5 to 9 inches thick and is medium acid or slightly acid.

The C horizon ranges from gray (5Y 5/1) to light olive gray (5Y 6/2). Texture ranges from medium silty clay loam to heavy silt loam at a depth of about 80 inches.

Zook series

The Zook series consists of poorly drained, slowly permeable soils. These soils are on low, flat flood plains that in many places are some distance from the main stream channel, often adjacent to the valley side. Zook soils also are in some drainageways. Zook soils formed in fine textured alluvium under grass and sedges tolerant of excessive wetness. Slope ranges from 0 to 2 percent.

Typical pedon of Zook silty clay loam, 0 to 2 percent slopes, on bottom land in a cultivated field, 100 feet

west and 300 feet north of the southeast corner of the NE1/4NE1/4 sec. 10, T. 77 N., R. 19 W.:

Ap—0 to 7 inches; black (N 2/0) silty clay loam; weak fine granular structure; friable; neutral; gradual clear boundary.

A12—7 to 16 inches; black (N 2/0) silty clay loam; weak fine granular structure; friable; neutral; gradual clear boundary.

A13—16 to 22 inches; black (10YR 2/1) heavy silty clay loam; faces of peds black (N 2/0); moderate medium subangular blocky structure; firm; neutral; gradual smooth boundary.

A3—22 to 39 inches; very dark gray (10YR 3/1) heavy silty clay loam; few fine distinct brown (7.5YR 4/4) mottles; moderate medium subangular blocky structure; firm; neutral; diffuse boundary.

Bg—39 to 53 inches; dark gray (10YR 4/1) heavy silty clay loam; common medium distinct light olive brown (2.5Y 5/6) and few fine distinct strong brown (7.5YR 5/8) mottles; moderate fine and medium subangular blocky structure; firm; neutral; gradual smooth boundary.

Cg—53 to 63 inches; gray (5Y 5/1) and light gray (5Y 6/1) heavy silty clay loam; few coarse distinct dark gray (5Y 4/1) and common fine distinct strong brown (7.5YR 5/8) mottles; massive; firm; neutral.

The solum ranges from 36 to 64 inches in thickness.

The A horizon is medium or heavy silty clay loam. The A horizon is 26 to 40 inches thick and ranges from medium acid to mildly alkaline.

The Bg horizon ranges from dark gray (10YR 4/1) to gray (5Y 5/1). Texture is heavy silty clay loam or silty clay. The Bg horizon is 10 to 20 inches thick and ranges from medium acid to mildly alkaline.

The Cg horizon ranges from very dark gray (10YR 3/1) to light gray (5Y 6/1). Texture is heavy silty clay loam or light silty clay. The Cg horizon ranges from medium acid to mildly alkaline.

Classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*14*). 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 17, 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 Argiudoll (*Argi,* meaning clayey horizons, 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 Argiudoll.

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.

Factors of soil formation

Soil is produced by soil-forming processes acting 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 forces of soil formation have acted on the soil material (*5*).

Climate and plant and animal life, chiefly plants, are the active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for differentiation of soil horizons. Usually, a long time 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

The soils in Marion County formed in shale (residual material), glacial till (ice-laid material), loess (windblown material), and alluvium (water-laid material). Small areas of eolian sands are along the major streams.

Shale.—Before the glaciers covered Iowa, shale, limestone, and sandstone were exposed on the land surface. Most of these materials were later covered by glacial till. In some areas geologic erosion has removed the till and reexposed the weathered rock. Shale occurs on the lower parts of side slopes mostly south and west of a line from the northwest corner to the southeast corner of the county. The shale bedrock consists of the Cherokee and Marmaton Groups of the Des Moines Series, which is of Pennsylvanian age (*4*).

Soils that formed in shale normally show only minimal profile development. The B horizon is only weakly expressed or is absent. These soils are normally quite acid and have low fertility. The Bauer and Gosport soils are the only soils in the county that formed in shale.

Glacial till.—Two glaciers, the Nebraskan and the Kansan, left deposits in Marion County. The Kansan drift is identifiable throughout the county and is on side slopes that form an extensive part of the landscape. Nebraskan drift is not readily identifiable on the surface in Marion County.

Soils formed on the Kansan till plain during the Yarmouth and Sangamon interglacial periods. On nearly level interstream divides, the soils were strongly weathered and had a gray plastic subsoil. These soils were later covered with loess. In places the gray plastic subsoil, called gumbotil (*6*), has been reexposed by erosion. It is several feet thick and very slowly permeable. Clarinda soils formed in this gumbotil and are extensive throughout the county. Because the gumbotil in the Lamoni soils has been partly eroded away, the clay material is not so thick as that in the Clarinda soils.

During the late Sangamon interglacial period, geological erosion cut through the Yarmouth-Sangamon paleosol and into the Kansan till (*7*). At the level to which this erosion cut, there generally is a stone line or till that is overlain by pedisediment (*8, 11*). A soil formed in the Kansan till and was later covered with loess. Geologic erosion has removed the loess from many side slopes and exposed the paleosol. Adair soils fromed in this reexposed paleolol.

Caleb and Mystic soils formed in pre-Sangamon sediments that filled valleys. These sediments are of glacial origin and vary in texture. They are on low, stepped interfluves several feet above the present valley floor (*8*). They owe their landscape partly to the valley fill, but their surface merges with the surface of present eroded uplands. Caleb and Mystic soils are above the flood plain but lower than the Gara, Lindley, and Shelby soils, which formed in Kansan till on dissected slopes of late Wisconsin age.

Loess.—Loess of Wisconsin age covered most of Marion County and is an extensive parent material (*9, 10*). It consists of particles of silt and clay deposited by wind. Variations in soils are related to the distance of the soils from the loess source. The source of loess in Marion County is probably the Missouri River bottomland in western Iowa (*3*). Some soils along the major streams in Marion County contain less clay and probably include loess from local sources. On stable upland divides the loess is 12 to 14 feet thick.

Alluvium.—In Marion County there are three levels of alluvial benches. The highest level is 20 to 45 feet above the flood plain. Along the Des Moines and South Skunk Rivers these high alluvial benches are capped with loess more than 15 feet thick. The high, level benches along White Breast, English, and Cedar Creeks have a maximum of 10 to 12 feet of loess. This loess generally covers a soil that formed in old alluvium that is high is material derived from shale. Along these creeks, benches only 10 to 20 feet above the flood plain have 6 to 10 feet of loess over stratified silty clay loam, silt, and sand. At this level there is little or no evidence of a buried soil. Benches less than 10 feet above the flood plain along these creeks have soils that formed in alluvium and little or no loess.

Soils of the bottom lands formed almost entirely in alluvium. Because water sorts the sediments by particle size, the coarser textured soils are near the stream channel and the clayey soils are away from the stream channel towards the base of the uplands. Nodaway and Ackmore soils are silty and are near stream channels. Zook and Wabash soils are clayey and are away from the stream channel nearer the uplands.

Sediment at the foot of the slope from which it has eroded is called local alluvium or colluvium.

Climate

Climate is an important factor in the formation of soils. The soils of Marion County differ considerably from soils that formed in the dry climate of the Great Plains States or in the humid climate of the southeastern states.

The influence of the general climate in a region is modified by local conditions. For example, soils on south-facing slopes formed under a warmer and drier microclimate than soils that face north. The low-lying, poorly drained soils on bottom lands formed under a wetter and colder microclimate than soils in surrounding areas. These local differences influence the characteristics of the soil and account for some of the differences among soils in the same general climatic region.

Living organisms

Plants have been an important influence on the development of the soils of Marion County. Animals have influenced the soil to a lesser extent. Trees covered the more dissected areas along major streams, and prairie grasses dominated the gently rolling uplands. The type of vegetation has been both grass and trees during soil formation in areas of Gara, Ladoga, and Pershing soils.

Most soils that formed under trees are lighter colored, are more acid, and have a thinner surface layer than soils that formed under grasses. Soils that formed under a shifting vegetation are intermediate between soils that formed under grasses and soils that formed under trees.

Relief

Relief indirectly influences soil development through its effect on drainage. In Marion County soils range from level to very steep.

On bottom lands soils are flooded and water ponds in depressional areas. These soils have a permanent or fluctuating high water table. Nearly level soils also occur on broad upland divides. These soils have a high water table and pond water in depressions. The steepest soils in the county are along the south and east sides of major streams and their tributaries. The intricate pattern of upland drainageways indicates that in nearly all of the county the landscape has been modified by geological processes.

Generally, soils that formed where the water table is high have a subsoil that is dominantly grayish. Examples are Clearfield, Haig, Wabash, Winterset, and Zook soils. Macksburg and Grundy soils formed where the water table fluctuates, and they have a grayish brown subsoil. Sharpsburg and Shelby soils developed where the water table is below the subsoil, and they have a yellowish brown subsoil. Soils that are poorly drained normally have more organic matter in the surface layer than well drained soils if all other conditions are similar.

In similar soils that have a wide range in slope, the depth to carbonates is least where slopes are steepest, are convex, or are most unstable.

Time

The length of time a soil develops affects the kind of soil that forms. An older or more strongly developed soil shows well-defined genetic horizons. A less well developed soil shows no horizons or only weakly defined ones. Most soils on flood plains are not well developed because they have not been in place long enough for distinct horizons to form (*12*).

Material is generally removed from the steeper soils before there has been time for a thick profile with strong horizons to develop. Even if the material has been in place for a long time, the soil may still be immature because much of the water runs off rather than through the soil. Shelby, Gara, and Lindley soils developed on recently dissected slopes of late Wisconsin age (*7*). These soils therefore are no older than 11,000 to 14,000 years and probably are much younger.

Adair, Armstrong, Clarinda, Lamoni, and Mystic soils are among the oldest soils in the county (*9*). Clarinda and Lamoni soils developed in Kansan glacial till during the Yarmouth-Sangamon period. Adair, Armstrong, and Mystic soils formed in material deposited during the late Sangamon interglacial period. This material is much older than the loessal parent material of the Grundy, Haig, Macksburg, and Sharpsburg soils, which are no older than 14,000 to 16,000 years and may be considerably younger.

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Glossary

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 (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.

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.

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. Mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter.

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.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the sur-

rounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

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 (or contour farming). 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.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

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. 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 for 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 build-

ing 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.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

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.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity*.

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

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.

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 (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.

Gumbotil. A dark, leached, nonlaminated, very sticky clay that was formed by weathering of glacial till.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an 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.

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 areas. Areas that have little or no natural soil and support 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.

Paleosol. A soil that formed during the geological past and was buried and preserved by more recent sedimentation. This kind of buried soil is often reexposed on the modern surface by subsequent erosion.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 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

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

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 groundwater 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.

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.

Sinkhole. A depression in the landscape where limestone has been dissolved.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

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.

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).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

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. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying 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."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. 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.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further

divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the low lands 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.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

TABLES

TABLE 1.--TEMPERATURE AND PRECIPITATION

Month	Temperature[1]						Precipitation[1]				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily high	Average daily low	Average	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days[2]	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----	30.2	11.6	20.9	59	-20	0	0.99	.36	1.50	3	6.7
February---	36.4	17.6	27.0	63	-15	0	1.12	.41	1.68	3	5.7
March------	46.4	26.4	36.5	78	-2	40	2.27	.91	3.37	5	6.5
April------	62.8	40.0	51.4	86	19	117	3.72	2.07	5.06	7	1.0
May--------	74.0	50.9	62.5	90	30	393	4.09	2.30	5.53	8	.0
June-------	82.9	60.2	71.6	97	43	648	4.16	2.11	5.83	7	.0
July-------	86.8	64.5	75.7	100	48	797	4.12	1.76	6.03	7	.0
August-----	85.0	62.3	73.7	98	47	735	3.62	1.97	4.96	6	.0
September--	77.1	53.8	65.4	93	34	462	3.80	1.53	5.63	6	.0
October----	67.0	43.7	55.4	88	22	231	2.11	.58	3.32	4	.1
November---	49.6	29.9	39.8	74	3	18	1.81	.54	2.82	3	1.7
December---	35.8	18.5	27.2	63	-12	0	1.18	.62	1.63	3	6.9
Year-----	61.2	40.0	50.6	100	-20	3,441	32.99	26.17	39.43	62	28.6

[1]Recorded in the period 1951-73 at Knoxville, Iowa.

[2]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principle crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Temperature[1]		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 22	May 1	May 11
2 years in 10 later than--	April 17	April 25	May 6
5 years in 10 later than--	April 7	April 14	April 25
First freezing temperature in fall:			
1 year in 10 earlier than--	October 20	October 13	September 28
2 years in 10 earlier than--	October 23	October 18	October 3
5 years in 10 earlier than--	October 31	October 26	October 13

[1]Recorded in the period 1951-73 at Knoxville, Iowa.

TABLE 3.--GROWING SEASON

Probability	Daily minimum temperature during growing season[1]		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	189	174	148
8 years in 10	195	181	155
5 years in 10	207	194	170
2 years in 10	218	206	184
1 year in 10	224	213	192

[1]Recorded in the period 1951-73 at Knoxville, Iowa.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
8B	Judson silty clay loam, 2 to 5 percent slopes	620	0.2
8C	Judson silty clay loam, 5 to 9 percent slopes	580	0.2
11B	Colo-Ely silty clay loams, 2 to 5 percent slopes	9,750	2.8
13B	Nodaway-Vesser silt loams, 2 to 5 percent slopes	7,970	2.3
24D2	Shelby loam, 9 to 14 percent slopes, moderately eroded	4,250	1.2
24E2	Shelby loam, 14 to 18 percent slopes, moderately eroded	1,925	0.5
43	Bremer silty clay loam, 0 to 2 percent slopes	1,575	0.4
51	Vesser silt loam, 0 to 2 percent slopes	1,309	0.4
53	Riverwash	145	*
54	Zook silty clay loam, 0 to 2 percent slopes	6,150	1.7
54+	Zook silt loam, overwash, 0 to 2 percent slopes	3,300	0.9
63C	Chelsea loamy fine sand, 5 to 9 percent slopes	659	0.2
63E2	Chelsea loamy fine sand, 9 to 18 percent slopes, moderately eroded	258	0.1
65D2	Lindley loam, 9 to 14 percent slopes, moderately eroded	2,175	0.6
65E	Lindley loam, 14 to 18 percent slopes	7,400	2.1
65E3	Lindley clay loam, 14 to 18 percent slopes, severely eroded	342	0.1
65F	Lindley loam, 18 to 25 percent slopes	2,000	0.6
69C2	Clearfield silty clay loam, 5 to 9 percent slopes, moderately eroded	497	0.1
75	Givin silt loam, 0 to 2 percent slopes	534	0.2
76B	Ladoga silt loam, 2 to 5 percent slopes	9,840	2.8
76C2	Ladoga silt loam, 5 to 9 percent slopes, moderately eroded	19,498	5.5
76D2	Ladoga silt loam, 9 to 14 percent slopes, moderately eroded	13,484	3.8
80B	Clinton silt loam, 2 to 5 percent slopes	3,550	1.0
80C2	Clinton silt loam, 5 to 9 percent slopes, moderately eroded	14,678	4.1
80D2	Clinton silt loam, 9 to 14 percent slopes, moderately eroded	17,281	4.9
88	Nevin silty clay loam, 0 to 2 percent slopes	2,125	0.6
93D2	Shelby-Adair complex, 9 to 14 percent slopes, moderately eroded	738	0.2
94D2	Caleb-Mystic loams, 9 to 14 percent slopes, moderately eroded	1,607	0.5
98	Huntsville silt loam, 0 to 2 percent slopes	1,421	0.4
119	Muscatine silty clay loam, 0 to 2 percent slopes	474	0.1
120B	Tama silty clay loam, 2 to 5 percent slopes	1,211	0.3
120C2	Tama silty clay loam, 5 to 9 percent slopes, moderately eroded	1,278	0.4
120D2	Tama silty clay loam, 9 to 14 percent slopes, moderately eroded	744	0.2
130	Belinda silt loam, 0 to 2 percent slopes	209	0.1
131B	Pershing silt loam, 2 to 5 percent slopes	2,400	0.7
131C2	Pershing silt loam, 5 to 9 percent slopes, moderately eroded	10,218	2.9
132B	Weller silt loam, 2 to 5 percent slopes	335	0.1
132C2	Weller silt loam, 5 to 9 percent slopes, moderately eroded	3,125	0.9
133	Colo silty clay loam, 0 to 2 percent slopes	1,275	0.4
133B	Colo silty clay loam, 2 to 5 percent slopes	459	0.1
133+	Colo silt loam, 0 to 2 percent slopes	2,900	0.8
162B	Downs silt loam, 2 to 5 percent slopes	564	0.2
162C2	Downs silt loam, 5 to 9 percent slopes, moderately eroded	2,975	0.8
162D2	Downs silt loam, 9 to 14 percent slopes, moderately eroded	2,575	0.7
163B	Fayette silt loam, 2 to 5 percent slopes	542	0.2
163C2	Fayette silt loam, 5 to 9 percent slopes, moderately eroded	1,195	0.3
163D2	Fayette silt loam, 9 to 14 percent slopes, moderately eroded	1,021	0.3
163E2	Fayette silt loam, 14 to 18 percent slopes, moderately eroded	3,966	1.1
163F2	Fayette silt loam, 18 to 25 percent slopes, moderately eroded	504	0.1
179D2	Gara loam, 9 to 14 percent slopes, moderately eroded	8,250	2.3
179E2	Gara loam, 14 to 18 percent slopes, moderately eroded	4,625	1.3
179F	Gara loam, 18 to 25 percent slopes	922	0.3
185D	Bauer silt loam, 9 to 14 percent slopes	540	0.2
185D2	Bauer silt loam, 9 to 14 percent slopes, moderately eroded	1,675	0.5
185E2	Bauer silt loam, 14 to 18 percent slopes, moderately eroded	1,567	0.4
208	Landes loam, 0 to 2 percent slopes	613	0.2
212	Kennebec silt loam, 0 to 2 percent slopes	1,016	0.3
220	Nodaway silt loam, 0 to 2 percent slopes	13,475	3.8
222C	Clarinda silty clay loam, 5 to 9 percent slopes	244	0.1
222C2	Clarinda silty clay loam, 5 to 9 percent slopes, moderately eroded	685	0.2
230C	Clearfield-Arispe silty clay loams, 5 to 9 percent slopes	662	0.2
230C2	Clearfield-Arispe silty clay loams, 5 to 9 percent slopes, moderately eroded	7,200	2.0
248	Wabash silty clay loam, 0 to 2 percent slopes	282	0.1
273B	Olmitz loam, 2 to 5 percent slopes	451	0.1
273C	Olmitz loam, 5 to 9 percent slopes	650	0.2
279	Taintor silty clay loam, 0 to 2 percent slopes	5,400	1.5
280	Mahaska silty clay loam, 1 to 3 percent slopes	5,025	1.4
281B	Otley silty clay loam, 2 to 5 percent slopes	4,750	1.3
281C2	Otley silty clay loam, 5 to 9 percent slopes, moderately eroded	4,425	1.3
281D2	Otley silty clay loam, 9 to 14 percent slopes, moderately eroded	1,375	0.4

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
313D2	Gosport silt loam, 9 to 14 percent slopes, moderately eroded	10,003	2.8
313E2	Gosport silt loam, 14 to 18 percent slopes, moderately eroded	19,993	5.6
313F2	Gosport silt loam, 18 to 25 percent slopes, moderately eroded	7,650	2.2
315	Alluvial land-Landes complex, 0 to 2 percent slopes	450	0.1
362	Haig silt loam, 0 to 2 percent slopes	1,727	0.5
364B	Grundy silty clay loam, 2 to 5 percent slopes	5,800	1.6
368	Macksburg silty clay loam, 0 to 2 percent slopes	4,580	1.3
368B	Macksburg silty clay loam, 2 to 5 percent slopes	636	0.2
369	Winterset silty clay loam, 0 to 2 percent slopes	1,850	0.5
370B	Sharpsburg silty clay loam, 2 to 5 percent slopes	10,050	2.8
370C	Sharpsburg silty clay loam, 5 to 9 percent slopes	1,117	0.3
370C2	Sharpsburg silty clay loam, 5 to 9 percent slopes, moderately eroded	11,500	3.2
370D2	Sharpsburg silty clay loam, 9 to 14 percent slopes, moderately eroded	3,975	1.1
373E	Tallula-Downs silt loams, 12 to 20 percent slopes	251	0.1
428B	Ely silty clay loam, 2 to 5 percent slopes	1,052	0.3
430	Ackmore silt loam, 0 to 2 percent slopes	3,125	0.9
453	Tuskeego silt loam, 0 to 2 percent slopes	407	0.1
478G	Gosport-Rock outcrop complex, 25 to 60 percent slopes	2,000	0.6
485	Spillville loam, 0 to 2 percent slopes	1,610	0.5
570B	Nira silty clay loam, 2 to 5 percent slopes	739	0.2
570C2	Nira silty clay loam, 5 to 9 percent slopes, moderately eroded	3,270	0.9
822D2	Lamoni silty clay loam, 9 to 14 percent slopes, moderately eroded	6,050	1.7
831B	Pershing silt loam, benches, 2 to 5 percent slopes	400	0.1
870B	Sharpsburg silty clay loam, benches, 2 to 5 percent slopes	664	0.2
870C	Sharpsburg silty clay loam, benches, 5 to 9 percent slopes	600	0.2
876B	Ladoga silt loam, benches, 2 to 6 percent slopes	1,433	0.4
993D2	Gara-Armstrong complex, 9 to 14 percent slopes, moderately eroded	1,140	0.3
993E2	Gara-Armstrong complex, 14 to 18 percent slopes, moderately eroded	493	0.1
1075	Givin silt loam, benches, 0 to 2 percent slopes	659	0.2
1220	Nodaway silt loam, channeled, 0 to 2 percent slopes	1,734	0.5
1315	Alluvial land-Landes complex, channeled, 0 to 2 percent slopes	1,815	0.5
1316	Alluvial land, wet, 0 to 2 percent slopes	1,800	0.5
1368	Macksburg silty clay loam, benches, 0 to 2 percent slopes	379	0.1
5020G	Strip mine spoils, 25 to 80 percent slopes	5,000	1.4
5040	Cut and fill land	1,215	0.3
	Gravel pits and quarries	375	0.1
	Water	1,565	0.4
	Total	354,570	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	Grass-legume hay	Smooth bromegrass	Kentucky bluegrass
	Bu	Bu	Bu	Ton	AUM*	AUM*
8B---------- Judson	124	47	68	5.2	7.3	4.2
8C---------- Judson	119	45	65	5.0	7.1	4.1
11B---------- Colo-Ely	113	44	62	4.7	6.5	4.1
13B---------- Nodaway	104	39	57	4.4	6.0	3.9
24D2---------- Shelby	81	31	44	3.4	4.9	3.3
24E2---------- Shelby	66	25	36	2.7	4.0	2.1
43---------- Bremer	106	40	58	4.5	5.7	4.0
51---------- Vesser	95	36	52	4.0	5.0	3.7
53**. Riverwash						
54---------- Zook	96	36	53	4.0	4.0	4.0
54+---------- Zook	101	38	55	4.2	4.4	4.4
63C---------- Chelsea	52	20	39	1.8	3.0	1.8
63E2---------- Chelsea	---	---	30	1.5	2.5	1.5
65D2---------- Lindley	65	24	35	2.9	5.8	2.4
65E---------- Lindley	---	---	---	2.2	4.4	2.0
65E3---------- Lindley	---	---	---	---	2.0	1.8
65F---------- Lindley	---	---	---	---	2.0	1.8
69C2---------- Clearfield	88	33	48	3.5	5.8	3.5
75---------- Givin	119	45	65	5.0	7.3	4.2
76B---------- Ladoga	113	43	62	4.7	7.8	4.3
76C2---------- Ladoga	105	40	57	4.4	7.3	3.9

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Smooth bromegrass	Kentucky bluegrass
	Bu	Bu	Bu	Ton	AUM*	AUM*
76D2---------- Ladoga	96	36	53	4.0	6.7	3.7
80B---------- Clinton	107	41	59	4.5	6.4	4.0
80C2---------- Clinton	99	38	54	4.2	6.0	3.6
80D2---------- Clinton	90	34	50	3.8	5.3	3.5
88---------- Nevin	114	43	63	4.8	7.0	4.0
93D2---------- Shelby-Adair	71	27	39	3.0	4.2	2.8
94D2---------- Caleb-Mystic	61	24	33	2.6	3.5	2.1
98---------- Huntsville	130	45	71	5.5	7.8	4.2
119---------- Muscatine	131	50	72	5.5	7.8	4.2
120B---------- Tama	125	48	69	5.2	7.5	4.2
120C2---------- Tama	117	44	64	4.9	7.0	3.8
120D2---------- Tama	108	41	59	4.5	6.3	3.3
130---------- Belinda	87	33	48	3.7	6.2	3.7
131B---------- Pershing	101	38	56	4.2	7.0	3.8
131C2---------- Pershing	91	33	50	3.8	6.4	3.4
132B---------- Weller	95	36	52	4.0	6.7	3.8
132C2---------- Weller	85	32	46	3.2	5.3	3.5
133---------- Colo	104	40	57	4.2	5.5	4.2
133B---------- Colo	102	39	56	4.0	5.3	4.2
133+---------- Colo	109	42	60	4.3	5.8	4.2
162B---------- Downs	119	45	65	5.0	7.1	4.1
162C2---------- Downs	111	42	61	4.7	6.5	3.8
162D2---------- Downs	102	39	56	4.3	6.0	3.6

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Smooth bromegrass	Kentucky bluegrass
	Bu	Bu	Bu	Ton	AUM*	AUM*
163B---------- Fayette	113	43	62	4.7	6.6	4.0
163C2---------- Fayette	108	41	59	4.5	6.5	3.8
163D2---------- Fayette	99	38	54	4.2	6.0	3.6
163E2---------- Fayette	84	32	46	3.5	5.0	3.3
163F2---------- Fayette	---	---	40	3.4	4.8	3.1
179D2---------- Gara	75	28	41	3.1	4.5	2.5
179E2---------- Gara	---	---	36	2.2	---	1.5
179F---------- Gara	---	---	---	1.5	---	1.3
185D---------- Bauer	---	---	---	2.5	3.5	2.8
185D2---------- Bauer	---	---	---	2.5	2.8	2.3
185E2---------- Bauer	---	---	---	1.5	---	2.0
208---------- Landes	82	29	53	3.3	---	2.5
212---------- Kennebec	121	46	66	5.1	7.1	4.2
220---------- Nodaway	110	42	60	4.6	6.5	4.0
222C---------- Clarinda	63	24	34	2.6	3.7	2.7
222C2---------- Clarinda	55	21	30	2.2	3.3	2.3
230C---------- Clearfield-Arispe	96	36	60	3.9	6.1	3.6
230C2---------- Clearfield-Arispe	93	35	57	3.7	5.9	3.5
248---------- Wabash	80	35	47	2.5	3.5	2.8
273B---------- Olmitz	100	38	55	4.2	6.0	3.9
273C---------- Olmitz	95	36	52	4.0	5.7	3.7
279---------- Taintor	117	44	64	4.7	7.8	4.2
280---------- Mahaska	119	45	65	5.0	7.3	4.2

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Smooth bromegrass	Kentucky bluegrass
	Bu	Bu	Bu	Ton	AUM*	AUM*
281B---------- Otley	119	45	65	5.0	7.3	4.3
281C2---------- Otley	111	42	61	4.7	7.0	3.9
281D2---------- Otley	102	39	56	4.3	6.8	3.7
313D2---------- Gosport	---	---	---	---	1.7	1.0
313E2, 313F2---------- Gosport	---	---	---	---	---	1.0
315---------- Alluvial land	---	---	---	---	---	1.0
362---------- Haig	105	40	58	4.2	7.0	3.8
364B---------- Grundy	107	41	59	4.5	7.0	4.0
368---------- Macksburg	121	46	67	5.1	7.4	4.5
368B---------- Macksburg	117	44	64	4.9	7.2	4.2
369---------- Winterset	117	44	64	4.9	7.2	4.3
370B---------- Sharpsburg	113	43	62	4.7	6.8	4.2
370C---------- Sharpsburg	108	41	59	4.5	6.3	4.1
370C2---------- Sharpsburg	105	40	58	4.4	6.0	4.0
370D2---------- Sharpsburg	96	36	53	4.0	5.7	3.8
373E---------- Tallula-Downs	78	30	43	3.3	4.3	3.3
428B---------- Ely	124	47	68	5.3	7.5	4.0
430---------- Ackmore	106	40	58	4.5	6.3	3.8
453---------- Tuskeego	82	31	45	3.3	4.3	3.3
478G---------- Gosport-Rock outcrop	---	---	---	---	---	---
485---------- Spillville	122	46	67	5.1	7.3	4.2
570B---------- Nira	114	43	63	4.8	6.5	4.5
570C2---------- Nira	106	40	58	4.5	5.7	3.9

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Smooth bromegrass	Kentucky bluegrass
	Bu	Bu	Bu	Ton	AUM*	AUM*
822D2---------- Lamoni	61	23	33	2.6	3.7	2.1
831B---------- Pershing	101	38	56	4.2	6.0	3.8
870B---------- Sharpsburg	113	43	62	4.7	6.8	4.2
870C---------- Sharpsburg	108	41	59	4.5	6.3	4.1
876B---------- Ladoga	113	43	62	4.7	6.8	4.3
993D2---------- Gara-Armstrong	69	26	37	2.8	4.0	2.3
993E2---------- Gara-Armstrong	60	23	33	2.4	3.5	1.6
1075---------- Givin	119	45	65	5.0	8.3	4.2
1220---------- Nodaway	---	---	---	3.0	5.5	4.0
1315---------- Alluvial land	---	---	---	---	---	---
1316**. Alluvial land						
1368---------- Macksburg	121	46	67	5.1	7.2	4.5
5020G**. Strip mine spoils						
5040**. Cut and fill land						

* 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 a period of 30 days.

** See map unit description for the composition and behavior of the map unit.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that the information was not available]

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Common trees	Site index	
8B, 8C---------- Judson	2o	Slight	Slight	Slight	Moderate	Black walnut--------	73	Black walnut, eastern cottonwood, green ash.
						White oak----------	---	
						Northern red oak----	---	
13B*: Nodaway---------	3o	Slight	Slight	Slight	Moderate	White oak----------	65	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple.
Vesser.								
43---------- Bremer	3w	Slight	Severe	Moderate	Severe	Eastern cottonwood--	90	American sycamore, common hackberry, green ash, eastern cottonwood, silver maple, northern white-cedar.
						Silver maple--------	80	
63C, 63E2-------- Chelsea	4s	Slight	Slight	Moderate	Slight	White oak----------	65	Eastern white pine, Scotch pine, European larch, eastern redcedar, red pine, jack pine.
65D2---------- Lindley	5o	Slight	Slight	Slight	Slight	Blackjack oak-------	50	White oak, green ash, yellow-poplar, post oak, blackjack oak, black oak.
						Black oak----------	---	
65E---------- Lindley	4r	Moderate	Moderate	Slight	Slight	White oak----------	60	White oak, green ash, yellow-poplar, post oak, blackjack oak, black oak.
						Post oak----------	---	
						Blackjack oak-------	---	
						Black oak----------	---	
65E3---------- Lindley	5r	Moderate	Moderate	Moderate	Slight	Blackjack oak-------	50	White oak, green ash, yellow-poplar, post oak, blackjack oak, black oak.
						Black oak----------	---	
65F---------- Lindley	4r	Moderate	Moderate	Slight	Slight	White oak----------	60	White oak, green ash, yellow-poplar, post oak, blackjack oak, black oak.
						Post oak----------	---	
						Blackjack oak-------	---	
						Black oak----------	---	

See footnote at end of table.

TABLE 6.--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	Plant competition	Common trees	Site index	
76B, 76C2, 76D2---- Ladoga	3o	Slight	Slight	Slight	Moderate	White oak----------	65	Eastern white pine, red pine, Norway spruce, Scotch pine, European larch, eastern redcedar, sugar maple, white spruce.
						Northern red oak----	65	
80B, 80C2, 80D2---- Clinton	3o	Slight	Slight	Slight	Slight	White oak----------	65	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut.
						Northern red oak----	65	
94D2*:								
Caleb----------	4o	Slight	Slight	Slight	Slight	White oak----------	55	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple.
						Northern red oak----	55	
Mystic----------	4o	Slight	Slight	Slight	Slight	White oak----------	55	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple.
						Northern red oak----	55	
98---------- Huntsville	1o	Slight	Slight	Slight	Moderate	Eastern cottonwood--	110	Eastern cottonwood, black walnut, American sycamore, red maple, sugar maple, green ash, common hackberry.
						American sycamore---	---	
						Yellow-poplar-------	98	
						Cherrybark oak------	---	
						Sweetgum------------	---	
						Green ash-----------	---	
130---------- Belinda	5w	Slight	Moderate	Moderate	Severe	White oak----------	45	Eastern cottonwood, silver maple, laurel willow, American sycamore, green ash, northern white-cedar.
131B, 131C2-------- Pershing	4c	Slight	Slight	Severe	Slight	White oak----------	55	Eastern white pine, Scotch pine, Norway spruce, red pine, white spruce.
132B, 132C2-------- Weller	4c	Slight	Slight	Severe	Slight	White oak----------	55	Eastern white pine, Scotch pine, Norway spruce, white spruce, red pine, European larch, black walnut, sugar maple.

See footnote at end of table.

TABLE 6.--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	Plant competition	Common trees	Site index	
162B, 162C2, 162D2--Downs	3o	Slight	Slight	Slight	Moderate	White oak Northern red oak	65 65	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple.
163B, 163C2, 163D2--Fayette	3o	Slight	Slight	Slight	Moderate	White oak Northern red oak	65 65	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple.
163E2, 163F2--Fayette	3r	Moderate	Moderate	Slight	Moderate	White oak Northern red oak	65 65	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple.
179D2--Gara	4o	Slight	Slight	Slight	Slight	White oak Northern red oak	55 55	Eastern white pine, red pine, Norway spruce, Scotch pine.
179E2, 179F--Gara	4r	Moderate	Moderate	Slight	Slight	White oak Northern red oak	55 55	Eastern white pine, red pine, Norway spruce, Scotch pine.
208--Landes	1o	Slight	Slight	Slight	Moderate	Eastern cottonwood Yellow-poplar American sycamore Sweetgum Green ash	106 96 --- --- ---	Eastern cottonwood, yellow-poplar, American sycamore, sweetgum, green ash, black walnut, eastern white pine, sugar maple.
212--Kennebec	2o	Slight	Slight	Slight	Moderate	Black walnut Bur oak Common hackberry Green ash Eastern cottonwood	79 63 --- --- ---	Black walnut, bur oak, common hackberry, green ash, eastern cottonwood, American sycamore.
220--Nodaway	3o	Slight	Slight	Slight	Moderate	White oak	65	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple.
248--Wabash	4w	Slight	Severe	Moderate	Severe	Pin oak	75	Pin oak, pecan, eastern cottonwood.

See footnote at end of table.

TABLE 6.--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	Plant competition	Common trees	Site index	
313D2---------- Gosport	5c	Slight	Slight	Moderate	Slight	White oak----------	45	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, poplar.
313E2, 313F2------- Gosport	5c	Moderate	Moderate	Moderate	Slight	White oak----------	45	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, poplar.
315*: Alluvial land.								
Landes----------	1o	Slight	Slight	Slight	Moderate	Eastern cottonwood-- Yellow-poplar------- American sycamore--- Sweetgum---------- Green ash----------	106 96 --- --- ---	Eastern cottonwood, yellow-poplar, American sycamore, sweetgum, green ash, black walnut, eastern white pine, sugar maple.
364B---------- Grundy	---	---	---	---	---	----------	---	Eastern cottonwood, pin oak, silver maple, green ash.
370B, 370C, 370C2, 370D2---------- Sharpsburg	4o	Slight	Slight	Slight	Slight	Black oak---------- Black walnut-------- White oak---------- Common hackberry---- Green ash----------	60 60 --- --- ---	Black walnut, common hackberry, green ash.
373E*: Tallula----------	---	---	---	---	---	----------	---	Black walnut, green ash, red maple, white oak, eastern white pine, red pine, Scotch pine, eastern redcedar.
Downs----------	3r	Moderate	Moderate	Slight	Moderate	White oak---------- Northern red oak----	65 65	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple.
430---------- Ackmore	---	---	---	---	---	----------	---	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple, poplar.

See footnote at end of table.

TABLE 6.--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	Plant competition	Common trees	Site index	
453---------- Tuskeego	3w	Slight	Severe	Moderate	Severe	Eastern cottonwood-- Silver maple--------	90 80	Eastern cottonwood, silver maple, laurel willow, American sycamore, green ash, northern white-cedar.
831B---------- Pershing	4c	Slight	Slight	Slight	Slight	White oak----------	55	Eastern white pine, Scotch pine, Norway spruce, red pine, white spruce.
870B, 870C---------- Sharpsburg	4o	Slight	Slight	Slight	Slight	Black oak---------- Black walnut-------- White oak---------- Common hackberry---- Green ash----------	60 60 --- --- ---	Black walnut, common hackberry, green ash.
876B---------- Ladoga	3o	Slight	Slight	Slight	Moderate	White oak---------- Northern red oak----	65 65	Eastern white pine, red pine, Norway spruce, Scotch 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, Norway spruce, Scotch pine.
Armstrong---------	4c	Slight	Slight	Slight	Slight	White oak---------- Northern red oak----	55 55	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple, poplar.
993E2*:								
Gara----------	4r	Moderate	Moderate	Moderate	Moderate	White oak---------- Northern red oak----	55 55	Eastern white pine, red pine, Norway spruce, Scotch pine.
Armstrong---------	4c	Moderate	Moderate	Moderate	Moderate	White oak---------- Northern red oak----	55 55	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple, poplar.
1220---------- Nodaway	3o	Slight	Slight	Slight	Moderate	White oak----------	65	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple.

See footnote at end of table.

TABLE 6.--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	Plant competition	Common trees	Site index	
1315*: Alluvial land.								
Landes	1o	Slight	Slight	Slight	Moderate	Eastern cottonwood Yellow-poplar American sycamore Sweetgum Green ash	106 96 --- --- ---	Eastern cottonwood, yellow-poplar, American sycamore, sweetgum, green ash, black walnut, eastern white pine, sugar maple.

* See map unit description for the composition and behavior of the map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; the symbol > means greater than. Absence of an entry means that trees of the height class do not normally grow on this soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
8B, 8C---------- Judson	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
11B*: Colo-----------	Redosier dogwood, silky dogwood.	Siberian dogwood, bloodtwig dogwood, Tatarian honeysuckle, Zabel honeysuckle.	Laurel willow, Amur maple, northern white-cedar.	Green ash---------	Silver maple, eastern cottonwood.
Ely----------	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
13B*: Nodaway----------	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
Vesser----------	Redosier dogwood, silky dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash---------	Eastern cottonwood, silver maple.
24D2, 24E2-------- Shelby	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
43---------- Bremer	Redosier dogwood, silky dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Zabel honeysuckle, Siberian dogwood.	Laurel willow, northern white-cedar, Amur maple.	Green ash---------	Eastern cottonwood, silver maple.
51---------- Vesser	Redosier dogwood, silky dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash---------	Eastern cottonwood, silver maple.
53*. Riverwash					
54, 54+---------- Zook	Silky dogwood, redosier dogwood.	Siberian dogwood, Tatarian honeysuckle, Zabel honeysuckle, bloodtwig dogwood.	Northern white-cedar, laurel willow, Amur maple.	Green ash---------	Silver maple, eastern cottonwood.

See footnote at end of table.

TABLE 7.--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
63C, 63E2--------- Chelsea	Russian peashrub, gray dogwood, Koster redcedar.	Eastern redcedar, Russian-olive, Siberian crabapple, nannyberry viburnum.	Common hackberry, eastern white pine, red pine.	---	---
65D2, 65E, 65E3, 65F---------- Lindley	---	Flowering dogwood, eastern redbud, Amur honeysuckle, autumn-olive, rose-of-sharon, American cranberrybush.	Eastern redcedar, jack pine.	---	---
69C2---------- Clearfield	Redosier dogwood, silky dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash---------	Eastern cottonwood, silver maple.
75---------- Givin	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
76B, 76C2, 76D2--- Ladoga	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
80B, 80C2, 80D2--- Clinton	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
88---------- Nevin	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
93D2*: Shelby-----------	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
Adair----------	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
94D2*: Caleb----------	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
Mystic----------	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
98---------- Huntsville	Gray dogwood------	Amur honeysuckle, forsythia.	---	Douglas-fir, Norway spruce, red pine.	Eastern white pine.

See footnote at end of table.

TABLE 7.--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
119---------- Muscatine	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
120B, 120C2, 120D2---------- Tama	Redosier dogwood, gray dogwood.	Siberian dogwood, bloodtwig dogwood, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Silver maple, eastern cottonwood.
130---------- Belinda	Redosier dogwood, silky dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash---------	Eastern cottonwood, silver maple.
131B, 131C2------- Pershing	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
132B, 132C2------- Weller	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
133, 133B, 133+--- Colo	Redosier dogwood, silky dogwood.	Siberian dogwood, bloodtwig dogwood, Tatarian honeysuckle, Zabel honeysuckle.	Laurel willow, Amur maple, northern white-cedar.	Green ash---------	Silver maple, eastern cottonwood.
162B, 162C2, 162D2---------- Downs	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
163B, 163C2, 163D2, 163E2----- Fayette	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
163F2. Fayette					
179D2, 179E2------ Gara	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
179F. Gara					
185D, 185D2, 185E2---------- Bauer	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.

See footnote at end of table.

TABLE 7.--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
208---------- Landes	Silky dogwood, mockorange.	Amur maple, autumn-olive, American cranberrybush, blackhaw, late lilac, Amur honeysuckle.	White spruce------	Red pine----------	Eastern white pine, Norway spruce.
212---------- Kennebec	Gray dogwood, redosier dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Amur maple, eastern redcedar.	Red pine, common hackberry, Norway spruce.	Silver maple, eastern cottonwood.
220---------- Nodaway	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
222C, 222C2------- Clarinda	Redosier dogwood, silky dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash---------	Eastern cottonwood, silver maple.
230C*, 230C2*: Clearfield-------	Redosier dogwood, silky dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash---------	Eastern cottonwood, silver maple.
Arispe----------	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
248---------- Wabash	Silky dogwood-----	Medium purple willow, Tatarian honeysuckle, Amur honeysuckle, redosier dogwood.	Oriental arborvitae, eastern redcedar, American basswood.	Green ash, pin oak, pussy willow.	Eastern cottonwood.
273B, 273C-------- Olmitz	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Amur maple, eastern redcedar.	Red pine, Norway spruce, common hackberry.	Silver maple, eastern cottonwood.
279---------- Taintor	Redosier dogwood, silky dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash---------	Eastern cottonwood, silver maple.
280---------- Mahaska	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
281B, 281C2, 281D2---------- Otley	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.

See footnote at end of table.

TABLE 7.--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
313D2, 313E2----- Gosport	Redosier dogwood, gray dogwood.	Siberian dogwood, bloodtwig dogwood, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
313F2. Gosport					
315*: Alluvial land.					
Landes----------	Silky dogwood, mockorange.	Amur maple, autumn-olive, American cranberrybush, blackhaw, late lilac, Amur honeysuckle.	White spruce------	Red pine----------	Eastern white pine, Norway spruce.
362---------- Haig	Redosier dogwood, silky dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Zabel honeysuckle, Siberian dogwood.	Laurel willow, northern white-cedar, Amur maple.	Green ash---------	Eastern cottonwood, silver maple.
364B---------- Grundy	---	Tatarian honeysuckle, Amur honeysuckle, redosier dogwood, autumn-olive.	Pin oak, medium purple willow, eastern redcedar.	Eastern cottonwood, oriental arborvitae, green ash, eastern white pine, Norway spruce.	---
368, 368B--------- Macksburg	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
369---------- Winterset	Redosier dogwood, silky dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash---------	Eastern cottonwood, silver maple.
370B, 370C, 370C2, 370D2---------- Sharpsburg	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
373E*: Tallula----------	Gray dogwood------	Forsythia---------	Amur maple, autumn-olive.	Douglas-fir, Norway spruce, eastern white pine.	Red pine.
Downs----------	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
428B---------- Ely	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.

See footnote at end of table.

TABLE 7.--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
430---------- Ackmore	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Amur maple, eastern redcedar.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
453---------- Tuskeego	Redosier dogwood, silky dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash---------	Eastern cottonwood, silver maple.
478G*: Gosport.					
Rock outcrop.					
485---------- Spillville	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
570B, 570C2------- Nira	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
822D2---------- Lamoni	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
831B---------- Pershing	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
870B, 870C-------- Sharpsburg	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
876B---------- Ladoga	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
993D2*, 993E2*: Gara----------	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
Armstrong--------	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
1075---------- Givin	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
1220---------- Nodaway	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.

See footnote at end of table.

TABLE 7.--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
1315*: Alluvial land.					
Landes	Silky dogwood, mockorange.	Amur maple, autumn-olive, American cranberrybush, blackhaw, late lilac, Amur honeysuckle.	White spruce	Red pine	Eastern white pine, Norway spruce.
1316*. Alluvial land					
1368 Macksburg	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
5020G*. Strip mine spoils					
5040*. Cut and fill land					

* See map unit description for the composition and behavior of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
8B Judson	Slight	Slight	Moderate: slope.	Slight.
8C Judson	Slight	Slight	Severe: slope.	Slight.
11B*: Colo	Severe: floods, wetness.	Moderate: wetness, floods.	Severe: wetness, floods.	Moderate: wetness, floods.
Ely	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight.
13B*: Nodaway	Severe: floods.	Slight	Moderate: floods.	Slight.
Vesser	Severe: floods, wetness.	Moderate: wetness, floods.	Severe: wetness, floods.	Moderate: wetness, floods.
24D2 Shelby	Moderate: slope, percs slowly.	Moderate: slope.	Severe: slope.	Slight.
24E2 Shelby	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
43 Bremer	Severe: wetness, floods.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
51 Vesser	Severe: floods, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
53*. Riverwash				
54, 54+ Zook	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.
63C Chelsea	Moderate: too sandy.	Moderate: too sandy.	Severe: slope.	Moderate: too sandy.
63E2 Chelsea	Moderate: too sandy, slope.	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy.
65D2 Lindley	Moderate: slope, percs slowly.	Moderate: slope.	Severe: slope.	Slight.
65E Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
65E3 Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too clayey, slope.
65F Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
69C2 Clearfield	Severe: wetness, percs slowly.	Moderate: wetness, too clayey.	Severe: wetness, slope.	Moderate: wetness, too clayey.
75 Givin	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness, percs slowly.	Slight.
76B Ladoga	Slight	Slight	Moderate: slope.	Slight.
76C2 Ladoga	Slight	Slight	Severe: slope.	Slight.
76D2 Ladoga	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
80B Clinton	Slight	Slight	Moderate: slope.	Slight.
80C2 Clinton	Slight	Slight	Severe: slope.	Slight.
80D2 Clinton	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
88 Nevin	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight.
93D2*: Shelby	Moderate: slope, percs slowly.	Moderate: slope.	Severe: slope.	Slight.
Adair	Moderate: slope, wetness, percs slowly.	Moderate: wetness, slope.	Severe: slope.	Moderate: wetness, too clayey.
94D2*: Caleb	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Mystic	Moderate: slope, percs slowly.	Moderate: slope.	Severe: slope.	Slight.
98 Huntsville	Severe: floods.	Slight	Moderate: floods.	Slight.
119 Muscatine	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
120B---- Tama	Slight----	Slight----	Moderate: slope.	Slight.
120C2---- Tama	Slight----	Slight----	Severe: slope.	Slight.
120D2---- Tama	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
130---- Belinda	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, percs slowly.	Severe: wetness.
131B---- Pershing	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: slope, wetness, percs slowly.	Slight.
131C2---- Pershing	Moderate: wetness, percs slowly.	Moderate: wetness.	Severe: slope.	Slight.
132B---- Weller	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: slope, wetness.	Slight.
132C2---- Weller	Moderate: wetness, percs slowly.	Moderate: wetness.	Severe: slope.	Slight.
133---- Colo	Severe: floods, wetness.	Moderate wetness.	Severe: wetness, floods.	Moderate: wetness, floods.
133B---- Colo	Severe: floods, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
133+---- Colo	Severe: floods, wetness.	Moderate: wetness.	Severe: wetness, floods.	Moderate: wetness, floods.
162B---- Downs	Slight----	Slight----	Moderate: slope.	Slight.
162C2---- Downs	Slight----	Slight----	Severe: slope.	Slight.
162D2---- Downs	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
163B---- Fayette	Slight----	Slight----	Moderate: slope.	Slight.
163C2---- Fayette	Slight----	Slight----	Severe: slope.	Slight.
163D2---- Fayette	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
163E2, 163F2---- Fayette	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
179D2---- Gara	Moderate: percs slowly, slope.	Moderate: slope.	Severe: slope.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
179E2, 179F Gara	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
185D, 185D2 Bauer	Severe: percs slowly.	Moderate: slope.	Severe: slope, percs slowly.	Slight.
185E2 Bauer	Severe: slope, percs slowly.	Severe: slope.	Severe: slope, percs slowly.	Moderate: slope.
208 Landes	Severe: floods.	Slight	Slight	Slight.
212 Kennebec	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
220 Nodaway	Severe: floods.	Slight	Moderate: floods.	Slight.
222C, 222C2 Clarinda	Severe: percs slowly, wetness.	Moderate: wetness, too clayey.	Severe: slope, wetness, percs slowly.	Moderate: wetness, too clayey.
230C*, 230C2*: Clearfield	Severe: wetness.	Moderate: wetness, too clayey.	Severe: slope, wetness.	Moderate: wetness, too clayey.
Arispe	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Severe: slope.	Moderate: too clayey.
248 Wabash	Severe: floods, wetness, percs slowly.	Severe: wetness.	Severe: wetness, percs slowly.	Severe: wetness.
273B Olmitz	Slight	Slight	Moderate: slope.	Slight.
273C Olmitz	Slight	Slight	Severe: slope.	Slight.
279 Taintor	Severe: wetness.	Moderate: wetness, too clayey.	Severe: wetness.	Moderate: wetness, too clayey.
280 Mahaska	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight.
281B Otley	Slight	Slight	Moderate: slope.	Slight.
281C2 Otley	Slight	Slight	Severe: slope.	Slight.
281D2 Otley	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
313D2---------- Gosport	Severe: percs slowly.	Moderate: slope.	Severe: slope, percs slowly.	Slight.
313E2, 313F2---------- Gosport	Severe: percs slowly, slope.	Severe: slope.	Severe: slope, percs slowly.	Moderate: slope.
315*: Alluvial land.				
Landes----------	Severe: floods.	Slight----------	Slight----------	Slight.
362---------- Haig	Severe: wetness, percs slowly.	Moderate: wetness.	Severe: wetness, percs slowly.	Moderate: wetness.
364B---------- Grundy	Severe: wetness.	Moderate: wetness, too clayey.	Severe: wetness.	Moderate: wetness, too clayey.
368---------- Macksburg	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight.
368B---------- Macksburg	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight.
369---------- Winterset	Severe: wetness.	Moderate: wetness, too clayey.	Severe: wetness.	Moderate: wetness, too clayey.
370B---------- Sharpsburg	Slight----------	Slight----------	Moderate: slope.	Slight.
370C, 370C2---------- Sharpsburg	Slight----------	Slight----------	Severe: slope.	Slight.
370D2---------- Sharpsburg	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
373E*: Tallula----------	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Downs----------	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
428B---------- Ely	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight.
430---------- Ackmore	Severe: floods, wetness.	Moderate: wetness, floods.	Severe: wetness, floods.	Moderate: wetness, floods.
453---------- Tuskeego	Severe: wetness, percs slowly, floods.	Severe: wetness.	Severe: wetness, percs slowly.	Severe: wetness.
478G*: Gosport----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
478G*: Rock outcrop.				
485---- Spillville	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
570B---- Nira	Slight----	Slight----	Moderate: slope.	Slight.
570C2---- Nira	Slight----	Slight----	Severe: slope.	Slight.
822D2---- Lamoni	Severe: wetness, percs slowly.	Moderate: slope, wetness.	Severe: slope, wetness.	Moderate: wetness, too clayey.
831B---- Pershing	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: slope, wetness, percs slowly.	Slight.
870B---- Sharpsburg	Slight----	Slight----	Moderate: slope.	Slight.
870C---- Sharpsburg	Slight----	Slight----	Severe: slope.	Slight.
876B---- Ladoga	Slight----	Slight----	Moderate: slope.	Slight.
993D2*: Gara----	Moderate: percs slowly, slope.	Moderate: slope.	Severe: slope.	Slight.
Armstrong----	Moderate: slope, wetness, percs slowly.	Moderate: slope, wetness, too clayey.	Severe: slope.	Moderate: too clayey.
993E2*: Gara----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Armstrong----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too clayey, slope.
1075---- Givin	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight.
1220---- Nodaway	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
1315*: Alluvial land.				
Landes----	Severe: floods.	Slight----	Slight----	Slight.
1316*. Alluvial land				

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
1368---------- Macksburg	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight.
5020G*. Strip mine spoils				
5040*. Cut and fill land				

* See map unit description for the composition and behavior of the map unit.

TABLE 9.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates 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
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.
13B*: Nodaway----------	Good	Good	Good	Good	Fair	Fair	Poor	Fair	Good	Fair.
Vesser----------	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
24D2---------- Shelby	Fair	Good	Fair	Good	Good	Poor	Poor	Fair	Good	Poor.
24E2---------- Shelby	Poor	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Fair	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.
53*. Riverwash										
54, 54+---------- Zook	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
63C---------- Chelsea	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.
63E2---------- Chelsea	Very poor.	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
65D2---------- Lindley	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
65E, 65E3, 65F----- Lindley	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
69C2---------- Clearfield	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
75---------- Givin	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
76B---------- Ladoga	Good	Good	Fair	Good	Good	Poor	Poor	Good	Good	Poor.
76C2, 76D2--------- Ladoga	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Very poor.
80B---------- Clinton	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.

See footnote at end of table.

TABLE 9.--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
80C2, 80D2--------- Clinton	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	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.
94D2*: Caleb----------	Fair	Good	Fair	Good	Fair	Poor	Poor	Fair	Good	Poor.
Mystic----------	Fair	Good	Fair	Good	Fair	Poor	Poor	Fair	Good	Poor.
98---------- Huntsville	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
119---------- Muscatine	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
120B---------- Tama	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
120C2, 120D2------- Tama	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
130---------- Belinda	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
131B---------- Pershing	Good	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
131C2---------- Pershing	Fair	Fair	Fair	Fair	Fair	Very poor.	Poor	Fair	Fair	Very poor.
132B---------- Weller	Good	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
132C2---------- Weller	Fair	Fair	Fair	Fair	Fair	Very poor.	Poor	Fair	Fair	Very poor.
133---------- Colo	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
133B---------- Colo	Good	Fair	Good	Fair	Poor	Fair	Very poor.	Fair	Fair	Poor.
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, 162D2------- Downs	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
163B---------- Fayette	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
163C2, 163D2------- Fayette	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
163E2, 163F2------- Fayette	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.

See footnote at end of table.

TABLE 9.--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
179D2---- Gara	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Poor.
179E2, 179F---- Gara	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
185D, 185D2---- Bauer	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.
185E2---- Bauer	Poor	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
208---- Landes	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
212---- Kennebec	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
220---- Nodaway	Good	Good	Good	Good	Fair	Fair	Poor	Fair	Good	Fair.
222C, 222C2---- Clarinda	Poor	Fair	Poor	Fair	Poor	Poor	Poor	Fair	Fair	Poor.
230C*, 230C2*:										
Clearfield----	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
Arispe----	Good	Good	Good	Good	Good	Very poor.	Poor	Good	Good	Very poor.
248---- Wabash	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
273B---- Olmitz	Good	Good	Fair	Good	Good	Poor	Poor	Good	Good	Poor.
273C---- Olmitz	Fair	Good	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
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.
281C2, 281D2---- Otley	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Very poor.
313D2, 313E2, 313F2---- Gosport	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
315*:										
Alluvial land.										
Landes----	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
362---- Haig	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
364B---- Grundy	Fair	Good	Fair	Good	Good	Fair	Fair	Fair	Good	Fair.

See footnote at end of table.

TABLE 9.--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
368, 368B---------- Macksburg	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
369---------- Winterset	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
370B---------- Sharpsburg	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
370C, 370C2, 370D2- Sharpsburg	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
373E*:										
Tallula----------	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Downs----------	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
428B---------- Ely	Good	Good	Good	Good	Good	Fair	Very poor.	Good	Good	Poor.
430---------- Ackmore	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
453---------- Tuskeego	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
478G*:										
Gosport----------	Very poor.	Very poor.	Fair	Fair	Fair	Very poor.	Very poor.	Very poor.	Fair	Very poor.
Rock outcrop.										
485---------- Spillville	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
570B---------- Nira	Good	Good	Fair	Good	Good	Poor	Poor	Good	Good	Poor.
570C2---------- Nira	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Very poor.
822D2---------- Lamoni	Fair	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
831B---------- Pershing	Good	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
870B---------- Sharpsburg	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
870C---------- Sharpsburg	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
876B---------- Ladoga	Good	Good	Fair	Good	Good	Poor	Poor	Good	Good	Poor.
993D2*:										
Gara----------	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Poor.
Armstrong---------	Fair	Good	Fair	Good	Fair	Very poor.	Poor	Fair	Good	Very poor.

See footnote at end of table.

TABLE 9.--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
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.
1075 Givin	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
1220 Nodaway	Good	Good	Good	Good	Fair	Fair	Poor	Fair	Good	Fair.
1315*:										
Alluvial land.										
Landes	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
1316*.										
Alluvial land										
1368 Macksburg	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
5020G*.										
Strip mine spoils										
5040*.										
Cut and fill land										

* See map unit description for the composition and behavior of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
8B Judson	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: frost action, low strength.
8C Judson	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: frost action, low strength.
11B*: Colo	Severe: wetness, floods.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, low strength, wetness.
Ely	Moderate: wetness.	Severe: low strength.	Severe: low strength, wetness.	Severe: low strength.	Severe: frost action, low strength.
13B*: Nodaway	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action.
Vesser	Severe: wetness, floods.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.
24D2 Shelby	Moderate: slope.	Moderate: slope, shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: slope.	Severe: low strength.
24E2 Shelby	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
43 Bremer	Severe: wetness, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, frost action, floods.
51 Vesser	Severe: wetness, floods.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.	Severe: floods, frost action, low strength.
53*. Riverwash					
54, 54+ Zook	Severe: wetness, floods.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, low strength.
63C Chelsea	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
63E2 Chelsea	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
65D2--- Lindley	Moderate: too clayey, slope.	Moderate: shrink-swell, low strength, slope.	Moderate: shrink-swell, slope, low strength.	Severe: slope.	Severe: low strength.
65E, 65E3, 65F--- Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
69C2--- Clearfield	Severe: wetness.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, low strength, frost action.
75--- Givin	Severe: wetness.	Severe: low strength.	Severe: low strength.	Severe: low strength.	Severe: low strength, frost action.
76B, 76C2--- Ladoga	Slight---	Severe: low strength.	Severe: low strength.	Severe: low strength.	Severe: low strength.
76D2--- Ladoga	Moderate: slope.	Severe: low strength.	Severe: low strength.	Severe: slope, low strength.	Severe: low strength.
80B, 80C2--- Clinton	Slight---	Severe: low strength.	Severe: low strength.	Severe: low strength.	Severe: low strength.
80D2--- Clinton	Moderate: too clayey, slope.	Severe: low strength.	Severe: low strength.	Severe: slope, low strength.	Severe: low strength.
88--- Nevin	Severe: wetness.	Moderate: wetness, shrink-swell, low strength.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action, low strength.
93D2*: Shelby---	Moderate: slope.	Moderate: slope, shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: slope.	Severe: low strength.
Adair---	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness, slope.	Severe: low strength, frost action.
94D2*: Caleb---	Moderate: slope, wetness.	Moderate: low strength, slope.	Moderate: wetness, slope, shrink-swell.	Severe: slope.	Severe: low strength.
Mystic---	Moderate: slope, too clayey.	Moderate: shrink-swell, slope, low strength.	Moderate: wetness, shrink-swell, slope.	Severe: slope.	Severe: low strength, frost action.
98--- Huntsville	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action.
119--- Muscatine	Severe: wetness.	Moderate: wetness, low strength, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
120B---------- Tama	Slight----------	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: shrink-swell, low strength.	Severe: frost action, low strength.
120C2---------- Tama	Slight----------	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: slope, shrink-swell, low strength.	Severe: frost action, low strength.
120D2---------- Tama	Moderate: slope.	Moderate: slope, low strength, shrink-swell.	Moderate: slope, low strength, shrink-swell.	Severe: slope.	Severe: frost action, low strength.
130---------- Belinda	Severe: wetness.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, wetness, low strength.
131B, 131C2------- Pershing	Moderate: wetness, too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength, frost action.
132B, 132C2------- Weller	Severe: wetness.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength, wetness.	Severe: shrink-swell, low strength.	Severe: shrink-swell, frost action, low strength.
133, 133B, 133+--- Colo	Severe: wetness, floods.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, low strength.
162B---------- Downs	Slight----------	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: shrink-swell, low strength.	Severe: frost action, low strength.
162C2---------- Downs	Slight----------	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: slope, shrink-swell, low strength.	Severe: frost action, low strength.
162D2---------- Downs	Moderate: slope.	Moderate: slope, low strength, shrink-swell.	Moderate: slope, low strength, shrink-swell.	Severe: slope.	Severe: frost action, low strength.
163B---------- Fayette	Slight----------	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: shrink-swell, low strength.	Severe: frost action, low strength.
163C2---------- Fayette	Slight----------	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: slope, shrink-swell, low strength.	Severe: frost action, low strength.
163D2---------- Fayette	Moderate: slope.	Moderate: slope, shrink-swell, low strength.	Moderate: slope, low strength, shrink-swell.	Severe: slope.	Severe: frost action, low strength.
163E2, 163F2------ Fayette	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: frost action, low strength, slope.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
179D2--Gara	Moderate: slope.	Moderate: slope, shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: slope.	Severe: low strength.
179E2, 179F--Gara	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
185D, 185D2--Bauer	Moderate: too clayey, slope.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength.
185E2--Bauer	Severe: too clayey, slope.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, slope.
208--Landes	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, low strength.
212--Kennebec	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action, low strength.
220--Nodaway	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action.
222C, 222C2--Clarinda	Severe: wetness.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: frost action, shrink-swell, low strength.
230C*, 230C2*:					
Clearfield	Severe: wetness.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, low strength, frost action.
Arispe	Slight	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength, frost action.
248--Wabash	Severe: wetness, floods.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, low strength.
273B, 273C--Olmitz	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell.	Severe: low strength.
279--Taintor	Severe: wetness.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: frost action, shrink-swell, low strength.
280--Mahaska	Severe: wetness.	Severe: low strength.	Severe: wetness, low strength.	Severe: low strength,	Severe: low strength, frost action.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
281B, 281C2----- Otley	Slight----------	Severe: shrink-swell, low strength.	Severe: low strength.	Severe: low strength.	Severe: low strength.
281D2---------- Otley	Moderate: slope.	Severe: shrink-swell, low strength.	Severe: low strength.	Severe: slope, low strength.	Severe: low strength.
313D2---------- Gosport	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength.
313E2, 313F2------ Gosport	Severe: slope, too clayey.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, slope.
315*: Alluvial land.					
Landes----------	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, low strength.
362---------- Haig	Severe: wetness.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: frost action, shrink-swell, low strength.
364B---------- Grundy	Severe: wetness.	Severe: shrink-swell, low strength, wetness.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, wetness.	Severe: low strength, frost action, shrink-swell.
368, 368B--------- Macksburg	Severe: wetness.	Severe: low strength.	Severe: low strength.	Severe: low strength.	Severe: low strength, frost action.
369---------- Winterset	Severe: wetness.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: shrink-swell, frost action, low strength.
370B, 370C, 370C2- Sharpsburg	Slight----------	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: low strength.
370D2---------- Sharpsburg	Moderate: slope, too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, slope, low strength.	Severe: low strength.
373E*: Tallula----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.
Downs----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action, low strength.
428B---------- Ely	Moderate: wetness.	Severe: low strength.	Severe: low strength, wetness.	Severe: low strength.	Severe: frost action, low strength.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
430---------- Ackmore	Severe: floods, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, low strength, shrink-swell.
453---------- Tuskeego	Severe: wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: wetness, low strength, shrink-swell.
478G*:					
Gosport----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Rock outcrop.					
485---------- Spillville	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.
570B, 570C2------- Nira	Slight----------	Severe: low strength.	Severe: low strength.	Severe: low strength.	Severe: frost action, low strength.
822D2---------- Lamoni	Severe: wetness.	Severe: shrink-swell, low strength, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness, slope.	Severe: shrink-swell, low strength.
831B---------- Pershing	Moderate: wetness, too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength, frost action.
870B, 870C-------- Sharpsburg	Slight----------	Severe: low strength.	Severe: low strength.	Severe: low strength.	Severe: low strength.
876B---------- Ladoga	Slight----------	Severe: low strength.	Severe: low strength.	Severe: low strength.	Severe: low strength.
993D2*:					
Gara----------	Moderate: slope.	Moderate: slope, shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: slope.	Severe: low strength.
Armstrong--------	Severe: wetness.	Severe: shrink-swell, low strength.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, low strength, slope.	Severe: low strength, shrink-swell, frost action.
993E2*:					
Gara----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
Armstrong--------	Severe: wetness, slope.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, low strength, slope.	Severe: low strength, shrink-swell, frost action.
1075---------- Givin	Severe: wetness.	Severe: low strength.	Severe: wetness, low strength.	Severe: low strength.	Severe: frost action, low strength.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
1220--------- Nodaway	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action.
1315*: Alluvial land.					
Landes---------	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, low strength.
1316*. Alluvial land					
1368--------- Macksburg	Severe: wetness.	Severe: low strength.	Severe: low strength.	Severe: low strength.	Severe: low strength, frost action.
5020G*. Strip mine spoils					
5040*. Cut and fill land					

* See map unit description for the composition and behavior of the map unit.

TABLE 11.--SANITARY FACILITIES

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms used to rate soils. Absence of an entry means 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
8B Judson	Slight	Moderate: slope, seepage.	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.
Ely	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
13B*: Nodaway	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Fair: wetness.
Vesser	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
24D2 Shelby	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
24E2 Shelby	Severe: percs slowly, slope.	Severe: slope.	Moderate: too clayey, slope.	Severe: slope.	Poor: slope.
43 Bremer	Severe: percs slowly, floods, wetness.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
51 Vesser	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
53*. Riverwash					
54, 54+ Zook	Severe: percs slowly, wetness, floods.	Severe: wetness, floods.	Severe: wetness, too clayey, floods.	Severe: wetness, floods.	Poor: too clayey, wetness.
63C Chelsea	Slight**	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
63E2 Chelsea	Moderate:** slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.

See footnote at end of table.

TABLE 11.--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
65D2---------- Lindley	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: slope, too clayey.
65E, 65E3, 65F------ Lindley	Severe: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Severe: slope.	Poor: slope.
69C2---------- Clearfield	Severe: percs slowly, wetness.	Severe: slope.	Severe: wetness.	Severe: wetness.	Poor: wetness.
75---------- Givin	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
76B---------- Ladoga	Moderate: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight----------	Fair: too clayey.
76C2---------- Ladoga	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
76D2---------- Ladoga	Moderate: percs slowly, slope.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
80B---------- Clinton	Moderate: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight----------	Poor: too clayey.
80C2---------- Clinton	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight----------	Poor: too clayey.
80D2---------- Clinton	Moderate: percs slowly, slope.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Poor: too clayey.
88---------- Nevin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
93D2*: Shelby----------	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
Adair----------	Severe: percs slowly, wetness.	Severe: slope, wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: wetness.
94D2*: Caleb----------	Severe: wetness.	Severe: slope, wetness.	Moderate: wetness, too clayey.	Moderate: slope.	Fair: too clayey, wetness, slope.
Mystic----------	Severe: percs slowly, wetness.	Severe: slope, wetness, seepage.	Severe: seepage, too clayey.	Severe: seepage.	Poor: too clayey.
98---------- Huntsville	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
119---------- Muscatine	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.

See footnote at end of table.

TABLE 11.--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
120B---------- Tama	Slight----------	Moderate: slope, seepage.	Moderate: too clayey.	Slight----------	Fair: too clayey.
120C2---------- Tama	Slight----------	Severe: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
120D2---------- Tama	Moderate: slope.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: slope, too clayey.
130---------- Belinda	Severe: percs slowly, wetness.	Slight----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: wetness, too clayey.
131B---------- Pershing	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey.
131C2---------- Pershing	Severe: percs slowly, wetness.	Severe: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey.
132B---------- Weller	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey.
132C2---------- Weller	Severe: percs slowly, wetness.	Severe: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey.
133, 133B, 133+----- Colo	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
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.
162D2---------- Downs	Moderate: slope.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: slope, too clayey.
163B---------- Fayette	Moderate: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight----------	Fair: too clayey.
163C2---------- Fayette	Moderate: percs slowly.	Severe: slope, seepage.	Moderate: too clayey.	Slight----------	Fair: too clayey.
163D2---------- Fayette	Moderate: slope, percs slowly.	Severe: slope, seepage.	Moderate: too clayey.	Moderate: slope.	Fair: slope, too clayey.
163E2, 163F2-------- Fayette	Severe: slope.	Severe: slope, seepage.	Moderate: slope, too clayey.	Severe: slope.	Poor: slope.
179D2---------- Gara	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.

See footnote at end of table.

TABLE 11.--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
179E2, 179F--------- Gara	Severe: percs slowly, slope.	Severe: slope.	Moderate: too clayey, slope.	Severe: slope.	Poor: slope.
185D, 185D2--------- Bauer	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope, depth to rock.	Poor: too clayey, area reclaim.
185E2--------- Bauer	Severe: percs slowly, slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: too clayey, slope, area reclaim.
208--------- Landes	Severe: wetness.	Severe: seepage.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Good.
212--------- Kennebec	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Good.
220--------- Nodaway	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Fair: wetness.
222C, 222C2--------- Clarinda	Severe: wetness.	Severe: slope.	Severe: too clayey, wetness.	Severe: wetness.	Poor: too clayey, wetness.
230C*, 230C2*: Clearfield--------- Arispe----------	Severe: percs slowly, wetness. Severe: percs slowly.	Severe: slope. Severe: slope.	Severe: wetness. Moderate: too clayey, wetness.	Severe: wetness. Slight----------	Poor: wetness. Fair: too clayey, wetness.
248--------- Wabash	Severe: percs slowly, floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: wetness, too clayey.
273B--------- Olmitz	Moderate: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight----------	Fair: too clayey.
273C--------- Olmitz	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
279--------- Taintor	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: wetness, too clayey.
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.
281C2--------- Otley	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
281D2--------- Otley	Moderate: percs slowly, slope.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.

See footnote at end of table.

TABLE 11.--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
313D2---------- Gosport	Severe: percs slowly, depth to rock.	Severe: slope.	Severe: too clayey, depth to rock.	Moderate: slope.	Poor: too clayey, area reclaim.
313E2, 313F2-------- Gosport	Severe: slope, percs slowly, depth to rock.	Severe: slope.	Severe: too clayey, depth to rock.	Severe: slope.	Poor: too clayey, slope, area reclaim.
315*: Alluvial land.					
Landes----------	Severe: wetness.	Severe: seepage.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Good.
362---------- Haig	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: wetness, too clayey.
364B---------- Grundy	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey, wetness.	Severe: wetness.	Poor: too clayey, wetness.
368, 368B---------- Macksburg	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
369---------- Winterset	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: wetness, too clayey.
370B---------- Sharpsburg	Moderate: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight----------	Fair: too clayey.
370C, 370C2--------- Sharpsburg	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
370D2---------- Sharpsburg	Moderate: percs slowly, slope.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
373E*: Tallula----------	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
Downs----------	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
428B---------- Ely	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
430---------- Ackmore	Severe: percs slowly, floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
453---------- Tuskeego	Severe: wetness.	Slight----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: wetness, too clayey.
478G*: Gosport----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Rock outcrop.					

See footnote at end of table.

TABLE 11.--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
485---------- Spillville	Severe: wetness, floods.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, floods.	Fair: wetness.
570B---------- Nira	Moderate: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight----------	Fair: too clayey.
570C2---------- Nira	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
822D2---------- Lamoni	Severe: percs slowly, wetness.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, wetness.
831B---------- Pershing	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey.
870B---------- Sharpsburg	Moderate: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight----------	Fair: too clayey.
870C---------- Sharpsburg	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
876B---------- Ladoga	Moderate: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight----------	Fair: too clayey.
993D2*: Gara----------	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
Armstrong----------	Severe: percs slowly, wetness.	Severe: slope, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
993E2*: Gara----------	Severe: percs slowly, slope.	Severe: slope.	Moderate: too clayey, slope.	Severe: slope.	Poor: slope.
Armstrong----------	Severe: percs slowly, slope, wetness.	Severe: slope, wetness.	Severe: wetness.	Severe: wetness, slope.	Poor: slope, wetness.
1075---------- Givin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
1220---------- Nodaway	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Fair: wetness.
1315*: Alluvial land.					
Landes----------	Severe: wetness.	Severe: seepage.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Good.
1316*. Alluvial land					

See footnote at end of table.

TABLE 11.--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
1368---------- Macksburg	Severe: wetness.	Severe: wetness.	Severe: too clayey, wetness.	Severe: wetness.	Fair: too clayey, wetness.
5020G*. Strip mine spoils					
5040*. Cut and fill land					

* See map unit description for the composition and behavior of the map unit.
**Rapid permeability may cause pollution of ground water.

TABLE 12.--CONSTRUCTION MATERIALS

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and "poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
8B, 8C Judson	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
11B*: Colo	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Ely	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
13B*: Nodaway	Fair: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Vesser	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
24D2 Shelby	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, slope.
24E2 Shelby	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
43 Bremer	Poor: shrink-swell, wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
51 Vesser	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
53*. Riverwash				
54 Zook	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair. too clayey.
54+ Zook	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
63C, 63E2 Chelsea	Good	Good	Unsuited: excess fines.	Poor: too sandy.
65D2 Lindley	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, slope.
65E, 65E3, 65F Lindley	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
69C2 Clearfield	Poor: shrink-swell, low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
75 Givin	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
76B, 76C2---------- Ladoga	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
76D2---------- Ladoga	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, slope.
80B, 80C2---------- Clinton	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
80D2---------- Clinton	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, thin layer.
88---------- Nevin	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
93D2*: Shelby----------	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, slope.
Adair----------	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, slope.
94D2*: Caleb----------	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, too clayey.
Mystic----------	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, slope.
98---------- Huntsville	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
119---------- Muscatine	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
120B, 120C2---------- Tama	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
120D2---------- Tama	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
130---------- Belinda	Poor: shrink-swell, wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
131B, 131C2---------- Pershing	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
132B, 132C2---------- Weller	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
133, 133B, 133+-------- Colo	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
162B, 162C2---------- Downs	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
162D2---------- Downs	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
163B, 163C2---------- Fayette	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
163D2---------- Fayette	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, thin layer.
163E2, 163F2---------- Fayette	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
179D2---------- Gara	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, slope.
179E2, 179F---------- Gara	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
185D, 185D2---------- Bauer	Poor: thin layer, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, area reclaim, slope.
185E2---------- Bauer	Poor: thin layer, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
208---------- Landes	Fair: low strength.	Fair: excess fines.	Unsuited: excess fines.	Good.
212---------- Kennebec	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
220---------- Nodaway	Fair: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
222C, 222C2---------- Clarinda	Poor: shrink-swell, wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
230C*, 230C2*: Clearfield----------	Poor: shrink-swell, low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Arispe----------	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
248---------- Wabash	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness, too clayey.
273B, 273C---------- Olmitz	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
279---------- Taintor	Poor: shrink-swell, wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
280---------- Mahaska	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
281B, 281C2---------- Otley	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
281D2---------- Otley	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
313D2---------- Gosport	Poor: shrink-swell, area reclaim, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer.
313E2, 313F2---------- Gosport	Poor: shrink-swell, area reclaim, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, slope.
315*: Alluvial land.				
Landes----------	Fair: low strength.	Fair: excess fines.	Unsuited: excess fines.	Good.
362---------- Haig	Poor: shrink-swell, wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer.
364B---------- Grundy	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
368, 368B---------- Macksburg	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
369---------- Winterset	Poor: shrink-swell, wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
370B, 370C, 370C2----- Sharpsburg	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
370D2---------- Sharpsburg	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
373E*: Tallula----------	Fair: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Downs----------	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
428B---------- Ely	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
430--Ackmore	Poor: low strength, shrink-swell, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
453--Tuskeego	Poor: low strength, wetness, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: area reclaim.
478G*:				
Gosport	Poor: shrink-swell, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, slope.
Rock outcrop.				
485--Spillville	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
570B, 570C2--Nira	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
822D2--Lamoni	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
831B--Pershing	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
870B, 870C--Sharpsburg	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
876B--Ladoga	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
993D2*:				
Gara	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, slope.
Armstrong	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, too clayey.
993E2*:				
Gara	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Armstrong	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
1075--Givin	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
1220--Nodaway	Fair: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
1315*:				
Alluvial land.				
Landes	Fair: low strength.	Fair: excess fines.	Unsuited: excess fines.	Good.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1316*. Alluvial land				
1368---------- Macksburg	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
5020G*. Strip mine spoils				
5040*. Cut and fill land				

* See map unit description for the composition and behavior of the map unit.

TABLE 13.--WATER MANAGEMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. Absence of an entry means soil was not evaluated]

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
8B---------- Judson	Seepage---------	Favorable------	Not needed-----	Favorable------	Erodes easily--	Erodes easily.
8C---------- Judson	Slope, seepage.	Favorable------	Not needed-----	Slope----------	Erodes easily--	Erodes easily.
11B*: Colo----------	Seepage---------	Hard to pack, wetness.	Floods, frost action.	Floods, wetness.	Wetness--------	Wetness.
Ely----------	Seepage---------	Hard to pack---	Frost action---	Wetness--------	Erodes easily--	Erodes easily.
13B*: Nodaway----------	Seepage---------	Favorable------	Not needed-----	Floods, erodes easily.	Not needed-----	Erodes easily.
Vesser----------	Seepage---------	Wetness, hard to pack.	Floods, frost action.	Floods, wetness.	Wetness, erodes easily.	Erodes easily, wetness.
24D2---------- Shelby	Slope----------	Favorable------	Not needed-----	Slope----------	Favorable------	Erodes easily, slope.
24E2---------- Shelby	Slope----------	Favorable------	Not needed-----	Slope----------	Slope----------	Erodes easily, slope.
43---------- Bremer	Favorable------	Hard to pack---	Floods, frost action.	Wetness, floods.	Not needed-----	Wetness.
51---------- Vesser	Seepage---------	Wetness, hard to pack.	Floods, frost action.	Floods, wetness.	Not needed-----	Erodes easily, wetness.
53*. Riverwash						
54, 54+---------- Zook	Favorable------	Hard to pack, wetness.	Floods, percs slowly, frost action.	Floods, wetness, percs slowly.	Not needed-----	Wetness, percs slowly.
63C---------- Chelsea	Slope, seepage.	Piping, seepage.	Not needed-----	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
63E2---------- Chelsea	Slope, seepage.	Piping, seepage.	Not needed-----	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
65D2---------- Lindley	Slope----------	Favorable------	Not needed-----	Slope----------	Favorable------	Slope.
65E, 65E3, 65F---- Lindley	Slope----------	Favorable------	Not needed-----	Slope----------	Slope----------	Slope.
69C2---------- Clearfield	Slope, wetness.	Wetness, hard to pack.	Frost action, slope.	Wetness, percs slowly, slope.	Wetness, erodes easily.	Wetness, erodes easily
75---------- Givin	Seepage---------	Wetness, hard to pack.	Frost action---	Wetness--------	Not needed-----	Erodes easily.
76B---------- Ladoga	Seepage---------	Hard to pack---	Not needed-----	Favorable------	Erodes easily--	Erodes easily.
76C2---------- Ladoga	Seepage, slope.	Hard to pack---	Not needed-----	Slope----------	Erodes easily--	Erodes easily.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
76D2---------- Ladoga	Seepage, slope.	Hard to pack---	Not needed-----	Slope----------	Erodes easily--	Slope, erodes easily.
80B---------- Clinton	Seepage--------	Hard to pack---	Not needed-----	Erodes easily--	Favorable------	Erodes easily.
80C2---------- Clinton	Slope, seepage.	Hard to pack---	Not needed-----	Erodes easily, slope.	Favorable------	Erodes easily.
80D2---------- Clinton	Slope, seepage.	Hard to pack---	Not needed-----	Erodes easily, slope.	Favorable------	Slope, erodes easily.
88---------- Nevin	Seepage--------	Wetness--------	Frost action---	Wetness--------	Not needed-----	Erodes easily.
93D2*:						
Shelby----------	Slope----------	Favorable------	Not needed-----	Slope----------	Favorable------	Erodes easily, slope.
Adair----------	Slope----------	Favorable------	Percs slowly, frost action.	Wetness, percs slowly, slope.	Wetness, percs slowly.	Wetness, slope, percs slowly.
94D2*:						
Caleb----------	Slope, seepage.	Favorable------	Not needed-----	Slope----------	Favorable------	Slope.
Mystic----------	Slope, seepage.	Favorable------	Percs slowly, frost action, slope.	Erodes easily, percs slowly, slope.	Percs slowly---	Slope, erodes easily, percs slowly.
98---------- Huntsville	Seepage--------	Favorable------	Not needed-----	Floods---------	Not needed-----	Favorable.
119---------- Muscatine	Seepage--------	Wetness--------	Frost action---	Wetness--------	Not needed-----	Erodes easily.
120B---------- Tama	Seepage--------	Favorable------	Not needed-----	Favorable------	Erodes easily--	Erodes easily.
120C2---------- Tama	Slope, seepage.	Favorable------	Not needed-----	Slope----------	Erodes easily--	Erodes easily.
120D2---------- Tama	Slope, seepage.	Favorable------	Not needed-----	Slope----------	Erodes easily--	Slope, erodes easily.
130---------- Belinda	Favorable------	Wetness, hard to pack.	Percs slowly---	Wetness, percs slowly, erodes easily.	Not needed-----	Wetness, erodes easily.
131B---------- Pershing	Favorable------	Wetness, hard to pack.	Percs slowly, frost action.	Wetness, percs slowly.	Percs slowly, wetness.	Erodes easily, percs slowly.
131C2---------- Pershing	Slope----------	Wetness, hard to pack.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Percs slowly, wetness.	Erodes easily, percs slowly.
132B---------- Weller	Favorable------	Wetness, hard to pack.	Percs slowly, frost action.	Percs slowly, wetness.	Wetness, erodes easily.	Percs slowly, erodes easily.
132C2---------- Weller	Slope, seepage.	Wetness, hard to pack.	Slope, percs slowly, frost action.	Wetness, percs slowly, slope.	Wetness, erodes easily.	Percs slowly, erodes easily.
133---------- Colo	Seepage--------	Hard to pack---	Floods, frost action.	Floods, wetness.	Not needed-----	Wetness.
133B---------- Colo	Seepage--------	Hard to pack---	Floods, frost action.	Floods, wetness.	Wetness--------	Wetness.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
133+---------- Colo	Favorable------	Hard to pack, wetness.	Floods, frost action.	Floods, wetness.	Not needed-----	Wetness.
162B---------- Downs	Seepage--------	Favorable------	Not needed-----	Favorable------	Erodes easily--	Erodes easily.
162C2---------- Downs	Slope, seepage.	Favorable------	Not needed-----	Slope----------	Erodes easily--	Erodes easily.
162D2---------- Downs	Slope, seepage.	Favorable------	Not needed-----	Slope----------	Erodes easily--	Favorable.
163B---------- Fayette	Seepage--------	Favorable------	Not needed-----	Erodes easily--	Favorable------	Erodes easily.
163C2---------- Fayette	Slope, seepage.	Favorable------	Not needed-----	Slope, erodes easily.	Favorable------	Erodes easily.
163D2---------- Fayette	Slope, seepage.	Favorable------	Not needed-----	Slope, erodes easily.	Favorable------	Slope, erodes easily.
163E2, 163F2------ Fayette	Slope, seepage.	Favorable------	Not needed-----	Slope, erodes easily.	Slope----------	Slope, erodes easily.
179D2---------- Gara	Slope----------	Favorable------	Not needed-----	Slope----------	Favorable------	Erodes easily, slope.
179E2, 179F------- Gara	Slope----------	Favorable------	Not needed-----	Slope----------	Slope----------	Erodes easily, slope.
185D, 185D2------- Bauer	Slope----------	Thin layer, hard to pack.	Not needed-----	Droughty, percs slowly, slope.	Depth to rock, percs slowly.	Slope, erodes easily, droughty.
185E2---------- Bauer	Slope----------	Thin layer, hard to pack.	Not needed-----	Droughty, percs slowly, slope.	Slope, depth to rock, percs slowly.	Slope, erodes easily, droughty.
208---------- Landes	Seepage--------	Seepage, piping.	Not needed-----	Favorable------	Not needed-----	Favorable.
212---------- Kennebec	Seepage--------	Favorable------	Floods, frost action.	Floods, wetness.	Not needed-----	Erodes easily.
220---------- Nodaway	Seepage--------	Favorable------	Not needed-----	Floods, erodes easily.	Not needed-----	Erodes easily.
222C, 222C2------- Clarinda	Slope----------	Wetness, hard to pack.	Percs slowly, slope, frost action.	Wetness, percs slowly, slope.	Percs slowly, wetness.	Wetness, erodes easily, percs slowly.
230C*, 230C2*: Clearfield-------	Slope, wetness.	Wetness, hard to pack.	Frost action, slope.	Wetness, percs slowly, slope.	Wetness, erodes easily.	Wetness, erodes easily.
Arispe----------	Slope----------	Hard to pack---	Not needed-----	Slope----------	Erodes easily	Erodes easily.
248---------- Wabash	Favorable------	Wetness, hard to pack.	Floods, percs slowly.	Wetness, percs slowly.	Not needed-----	Percs slowly, wetness.
273B---------- Olmitz	Favorable------	Favorable------	Not needed-----	Favorable------	Favorable------	Favorable.
273C---------- Olmitz	Favorable------	Favorable------	Not needed-----	Slope----------	Favorable------	Favorable.
279---------- Taintor	Favorable------	Wetness, hard to pack.	Frost action---	Wetness--------	Not needed-----	Wetness, erodes easily.

See footnote at end of table.

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