SOIL SURVEY OF

Lake County, South Dakota

United States Department of Agriculture
Soil Conservation Service
In cooperation with
South Dakota Agricultural Experiment Station

Issued December 1973

Major fieldwork for this soil survey was done in the period 1960–66. Soil names and descriptions were approved in 1967. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1966. This survey was made cooperatively by the Soil Conservation Service and the South Dakota Agricultural Experiment Station. It is part of the technical assistance furnished to the Lake County Soil and Water Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Lake County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the capability unit, windbreak group, and pasture group in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about the use and management of the soils from the soil descriptions and from the discussions of the interpretive groups.

Foresters and others can refer to the section "Use of the Soils for Windbreaks," where the soils of the county are grouped according to their suitability for trees and shrubs.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Use of the Soils for Wildlife."

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in Lake County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the County," which gives additional information about the county.

Cover picture: **Terracing and contour stripcropping on Egan-Wentworth silty clay loams, 2 to 6 percent slopes.**

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Contents

Issued December 1973.

SOIL SURVEY OF LAKE COUNTY, SOUTH DAKOTA

BY LOREN D. SCHULTZ AND JAMES L. DRIESSEN, SOIL CONSERVATION SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE [1]

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION

LAKE COUNTY is in the east-central part of South Dakota (fig. 1). The total area is 372,480 acres, or about 582 square miles. Madison is the county seat and is the largest city in the county.

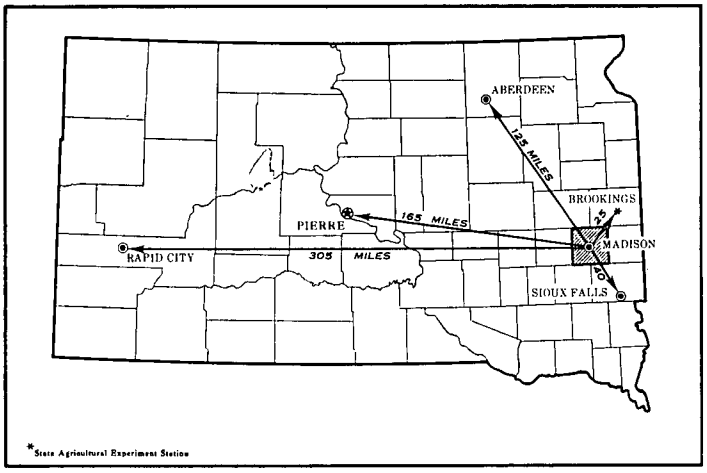

Figure 1.—**Location of Lake County in South Dakota.**

This county is on the southern end of the Prairie du Coteau physiographic area. Average elevation above sea level is about 1,700 feet. Relief typically is gently undulating. The western part of the county is drained by the East Fork of the Vermillion River. The balance of the county is drained by creeks, such as Battle and Skunk Creeks, that flow easterly to the Big Sioux River.

Farming is the main source of income in the county. Corn, oats, soybeans, flax, forage sorghums, alfalfa, and tame grass are the main crops. These crops are vital to the extensive livestock-raising operations. The main needs of management on the cultivated soils are control of erosion and maintenance of fertility.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Lake County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes; the size and speed of streams; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose 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 that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* (*5*) [2] are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Clarno and Wentworth, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Dempster silt loam, 0 to 2 percent slopes, is one of several phases within the Dempster series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from the aerial photographs.

[1] DANIEL R. COFFEE and ROBERT W. MATHENY, Soil Conservation Service, and EARL MONNENS, South Dakota Agricultural Experiment Station, assisted in preparing this survey.

[2] Italic numbers in parentheses refer to Literature Cited, page 76.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. One such mapping unit, the soil complex, is shown on the soil map of Lake County.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Egan-Ethan complex, 2 to 6 percent slopes, is an example.

In most areas surveyed, there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Sandy lake beaches is a land type in Lake County.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland and rangeland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then they adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Lake County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

Names and boundaries of the soil associations in Lake County do not necessarily coincide with those of previously published surveys of adjacent counties. This is because there are differences in detail of the general soil map and changes in the soil classification system.

The nine soil associations in Lake County are discussed in the following pages. Terms for texture used in the title apply to the surface layer. For example, in the title for association 1, the word "silty" refers to texture of the surface layer.

1. Lamo-Rauville association

Level and nearly level, somewhat poorly drained to very poorly drained, silty soils; on bottom lands

This association is in the southwestern part of the county. It consists of soils that formed in silty to clayey sediments deposited on the flood plains of the East Fork of the Vermillion River. The level and nearly level relief is interrupted by partly filled flood channels.

This association covers about 3 percent of the county. About 53 percent is made up of Lamo soils; 37 percent, of Rauville soils; and the remaining 10 percent, of other soils.

Lamo soils are deep, dark-gray silty clay loams that are calcareous at or near the surface. The underlying material is gray silty clay loam that is mottled with dark yellowish brown and is commonly stratified with thin layers of sandy material. Lamo soils are somewhat poorly drained. Rauville soils are calcareous and have a dark-gray surface layer that is silty clay loam in the upper part and silty clay in the lower part. The subsoil and underlying material are dark-gray silty clay. Rauville soils are in low areas (fig. 2) and in partly filled flood channels. They are poorly drained to very poorly drained.

The less extensive soils of this association are Davis and Enet soils on low terraces and terrace fans and Volga soils along channels and in oxbows at elevations slightly above the Lamo and Rauville soils.

The Lamo soils are used for crops and pasture, although farming operations generally are delayed in spring because of seasonal wetness. Corn is the main crop. Alfalfa and soybeans are also grown. The Rauville soils are too wet for cultivation and are used for hay and pasture.

The soils of this association have a high water table and are subject to flooding during spring thaws and after heavy rains. Engineering practices to improve drainage generally are feasible on the Lamo soils but not on the Rauville soils.

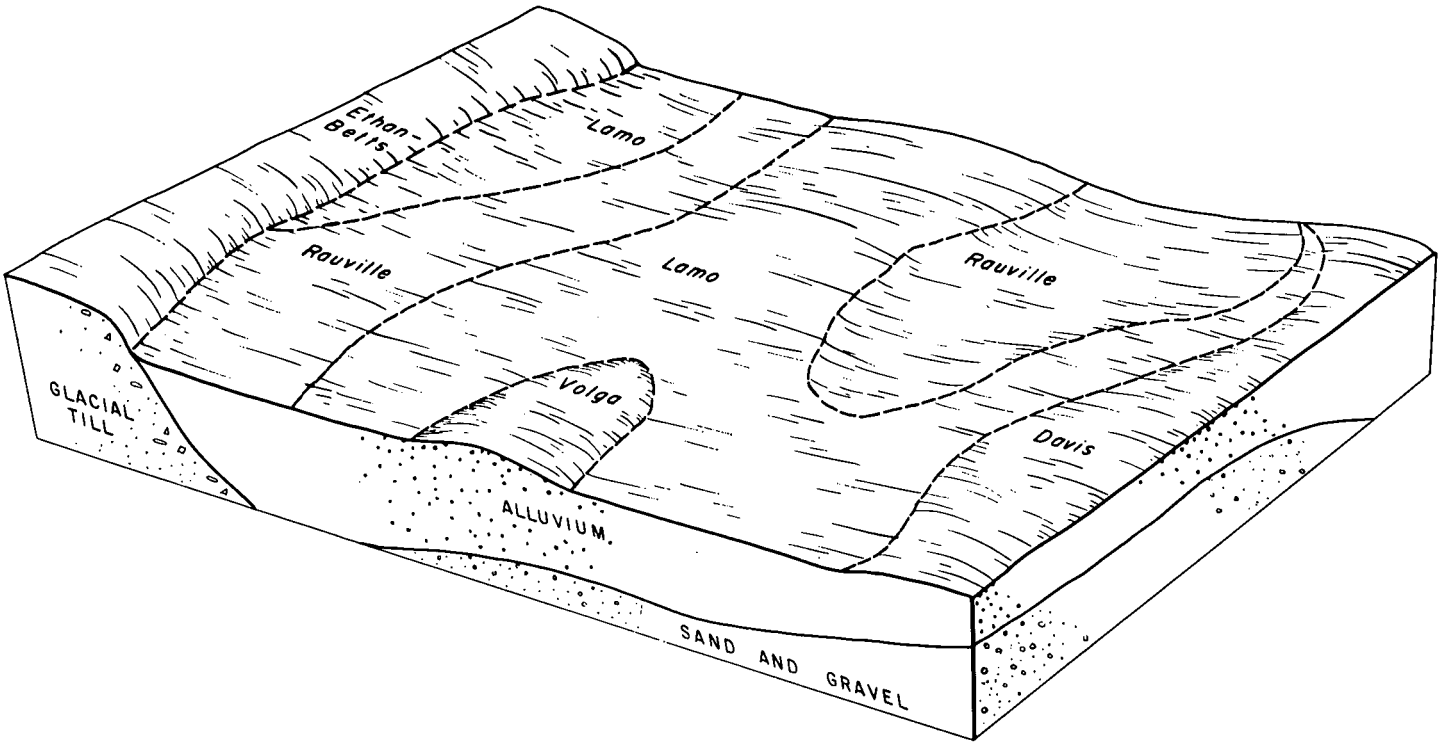

Figure 2.—**Relationship of soils to topography and underlying materials in the Lamo-Rauville association.**

2. *Dempster association*

Nearly level to sloping, well-drained, silty soils formed in alluvium over sand and gravel; on stream terraces and uplands

This association is in the eastern part of the county on terraces along Battle Creek and on glacial outwash plains on uplands south of Lake Madison and Brant Lake. The association consists mostly of nearly level and gently rolling areas interspersed with smaller areas of rounded ridges and knolls.

This association covers about 7 percent of the county. About 40 percent is made up of Dempster soils; about 40 percent, of water and marsh; and the remaining 20 percent, of less extensive soils.

Dempster soils have a dark grayish-brown silt loam surface layer and a friable, brown silty clay loam subsoil. The underlying material grades to sand and gravel at a depth of 30 to 40 inches. Dempster soils are nearly level to sloping and occur on the longer side slopes in the association.

The less extensive soils of this association are Graceville soils on slightly concave flats and in swales; Delmont and Talmo soils on convex ridges and knolls on uplands; Henkin soils on terraces and on side slopes of knolls and ridges on uplands; and small areas of Enet soils on stream terraces.

Most of this association is cultivated. Corn, small grain, and soybeans are suitable crops. These soils have moderate to low available water capacity and are droughty. They respond well to irrigation. Conservation of moisture and control of erosion are management needs.

3. *Clarno-Ethan association*

Nearly level to undulating, well-drained, loamy soils formed in glacial till; on uplands

This association is in the southwestern part of the county. The topography consists of short, irregular, convex slopes with intervening concave swales that feed into shallowly entrenched drainageways or terminate in flat-bottomed depressions.

This association makes up about 6 percent of the county. About 60 percent is made up of Clarno soils; 20 percent, of Ethan soils; and the remaining 20 percent, of less extensive soils.

Clarno soils have a surface layer of dark-gray loam and a subsoil of friable, grayish-brown clay loam. They are nearly level to undulating and occur on side slopes. Ethan soils have a surface layer of dark grayish-brown loam and a subsoil of friable, dark grayish-brown clay loam. They are calcareous at or near the surface and have a thinner subsoil than Clarno soils. Ethan soils are on shorter sloped, rounded knolls and hilltops in close association with Clarno soils.

The less extensive soils of this association are Prosper soils in concave swales; Tetonka soils in depressions; and Stickney soils in broad, nearly level swales between the depressions.

Most of this association is cultivated. Corn, small grain, and alfalfa are the principal crops grown. Tame pastures in bromegrass and small areas in native grasses provide grazing for livestock. Soils of this association generally are deficient in nitrogen and available phosphorus.

Control of erosion is a management need, and in cultivated areas eroded spots are easily observed because of

their light color. Use of mechanical conservation practices is difficult because of the short, irregular slopes.

4. Houdek-Prosper association

Nearly level to gently undulating, well drained and moderately well drained, loamy soils formed in glacial till; on uplands

This association is in the southwestern corner of the county. Many small depressions and swales are interspersed throughout the nearly level to gently undulating topography (fig. 3).

This association covers about 2 percent of the county. About 50 percent is made up of Houdek soils; 25 percent, of Prosper soils; and the remaining 25 percent, of less extensive soils.

Houdek soils have a dark-gray loam surface layer and a friable to firm, dark grayish-brown clay loam subsoil. They are well drained and have nearly level to gentle slopes that are plane to convex. Prosper soils have a thicker surface layer than Houdek soils and are deeper to lime. They are in swales and slightly depressional areas and are moderately well drained.

The less extensive soils of this association are Stickney soils in broad swales and drainageways and Tetonka soils in depressions. There are scattered areas of Beadle soils.

Most of this association is cultivated. Corn, small grain, and alfalfa are the main crops grown. Small areas are in native grass and are used for grazing. Control of water erosion is a need for management, and accumulation of runoff water in low areas and depressions is a limitation.

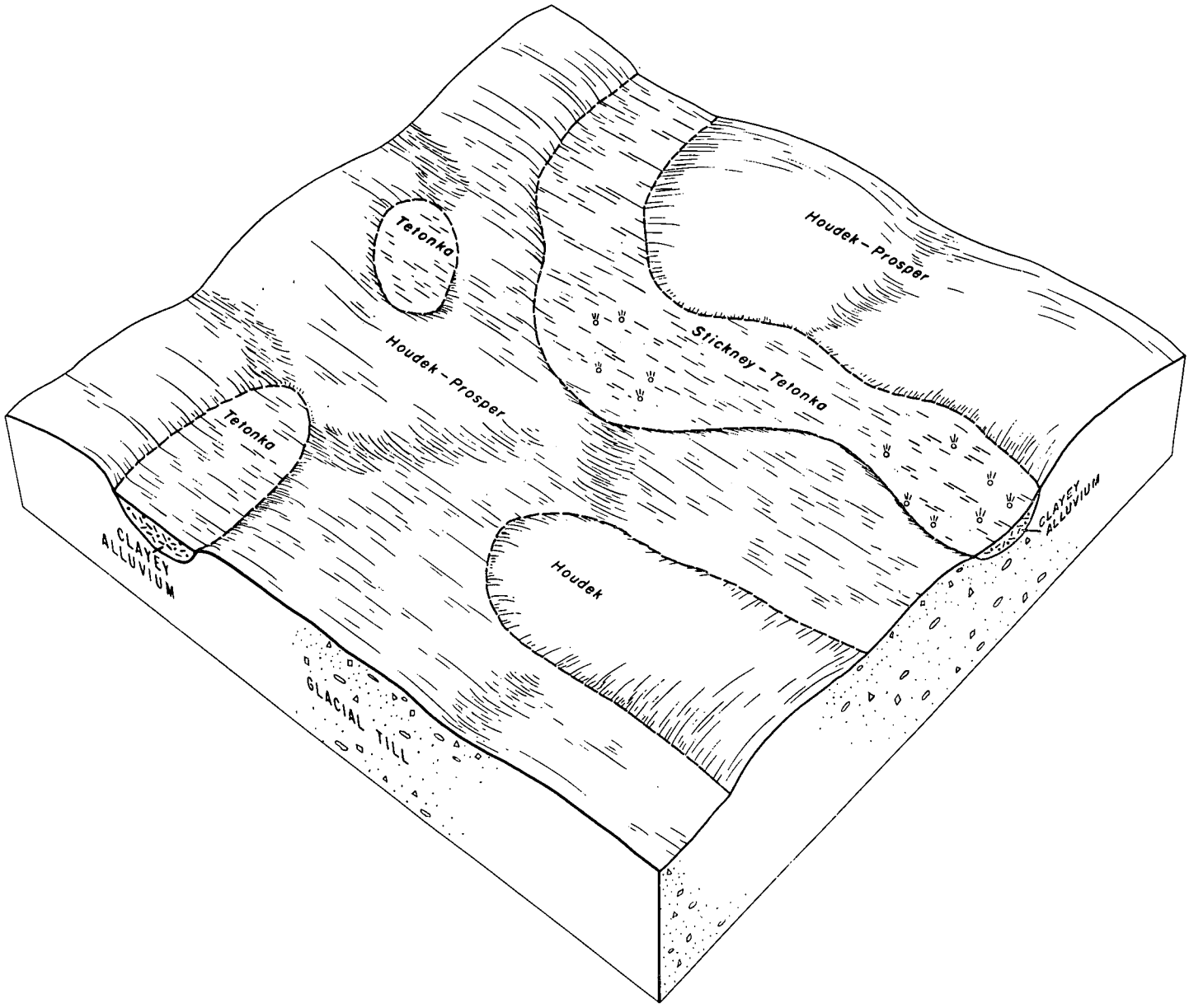

Figure 3.—**Relationship of soils to topography and underlying materials in the Houdek-Prosper association.**

5. *Egan-Viborg association*

Nearly level to gently sloping, well drained and moderately well drained, silty soils formed in glacial drift; on uplands

This association is in the central and northeastern parts of the county. Most areas are nearly level to gently sloping, but a few areas adjacent to drainageways are undulating to rolling.

This association covers 44 percent of the county. About 40 percent is made up of Egan soils; 25 percent, of Viborg soils; and the remaining 35 percent, of other soils.

Egan soils have a surface layer of dark grayish-brown silty clay loam and a subsoil of friable, brown to light brownish-gray silty clay loam. The underlying material is calcareous, light brownish-gray clay loam. Egan soils are well drained and have slightly convex slopes. Viborg soils have a dark-gray silty clay loam surface layer and a friable, dark-gray and grayish-brown silty clay loam subsoil. The underlying material is similar to that of the Egan soils, but the surface layer and subsoil are thicker. Viborg soils are moderately well drained and are in swales and slightly depressional areas.

Some of the less extensive soils are closely intermingled with Egan soils. Wentworth soils are on the mid and lower side slopes. Beadle and Ethan soils have the shorter slopes and are in the more undulating areas, where the silty drift material thins out over the clay loam till. Other less extensive soils in this association are Sinai soils on flat, mesalike hilltops; Whitewood soils in the broader swales and drainageways; and Badus and Worthing soils in depressions.

Most of this association is cultivated. Corn is the principal crop, but the soils are also well suited to small grain, soybeans, flax, alfalfa, and tame grasses. Control of water erosion is the main management need. Mechanical conservation practices generally are feasible in this association, except in a few areas where the irregularity of slopes makes their use difficult.

6. *Egan-Wentworth association*

Gently undulating to rolling, well-drained, silty soils formed in glacial drift; on uplands

This association is in several areas scattered throughout that part of the county east of the East Fork of the Vermillion River (fig. 4). The gently undulating to rolling topography is characteristic of glacial end moraines (fig. 5), and the silty drift contains more gravel and stones than the silty drift in the Egan-Viborg association.

This association covers about 22 percent of the county. About 40 percent is made up of Egan soils; about 20 percent, of Wentworth soils; and the remaining 40 percent, of less extensive soils.

Both the Egan and Wentworth soils are silty clay loam and have a dark grayish-brown surface layer and a friable subsoil that is brown or grayish brown in color, becoming light brownish gray in the lower part. Wentworth soils are more silty than Egan soils in the lower part of the subsoil and throughout the underlying material. Egan soils are on the convex, shorter, and more irregular slopes. Wentworth soils are on the lower parts of slopes.

The less extensive soils of this association are Beadle and Ethan soils in areas where the silty drift thins out over the clay loam till; Sinai soils on mesalike hilltops; Viborg and Whitewood soils in swales; and Worthing soils in depressions.

Most of this association is cultivated. Corn, small grain, soybeans, flax, and alfalfa are suitable crops. Many of the steeper slopes are used for pasture. Bromegrass is the tame grass used. A few small areas are in native grasses. Control of water erosion is the main management need. Mechanical conservation practices, such as terracing, are difficult to apply on the undulating slopes.

7. *Wentworth-Sinai association*

Nearly level to gently undulating, well-drained, silty and clayey soils formed in glacial drift; on uplands

The main area of this association is in the northwestern part of the county. Two smaller areas are south and west of Lake Herman. Most of this association is gently sloping and is marked by numerous, nearly level, mesalike hilltops. Stream drainage is ill defined, and runoff water collects in sloughs, lakes, and depressions.

This association covers about 13 percent of the county. Wentworth and Sinai soils each make up about 25 percent of the association, Egan soils 20 percent, and less extensive soils 30 percent.

Wentworth soils have a surface layer of dark grayish-brown silty clay loam and a subsoil of friable, brown silty clay loam. They are on the longer and smoother side slopes. Sinai soils have a dark-gray silty clay surface layer and a firm, dark grayish-brown and grayish-brown silty clay subsoil, becoming light brownish gray in the lower part. The underlying material is light brownish-gray and gray silty clay that contains many very dark brown and yellowish-brown mottles. Sinai soils are nearly level to gently sloping and are on mesalike hilltops. Egan soils are similar to Wentworth soils, except for their clay loam underlying material. Egan soils have the shorter and more convex slopes in the association.

The less extensive soils are Beadle soils in areas where the silty drift material thins out over the clay loam till; Viborg and Whitewood soils in swales; and Worthing soils in depressions.

Most of this association is cultivated. Corn, small grain, soybeans, flax, alfalfa, and tame grasses are suitable crops. Sinai soils and some of the less extensive soils are slow to dry out in spring, thus delaying planting operations. Control of erosion is the main management need.

8. *Moody-Nora association*

Nearly level to sloping, well-drained, silty soils formed in loess; on uplands

This association is in the southeastern corner of the county. Typical of the area are well-rounded ridges and side slopes where the soils are more sloping and long, smooth slopes where the soils are nearly level and gently sloping (fig. 6).

This association makes up about 1 percent of the county. It is about 35 percent Moody soils, 30 percent Nora soils, and 35 percent less extensive soils.

Moody soils have a surface layer of dark-gray silty clay loam and a subsoil of friable, brown silty clay loam.

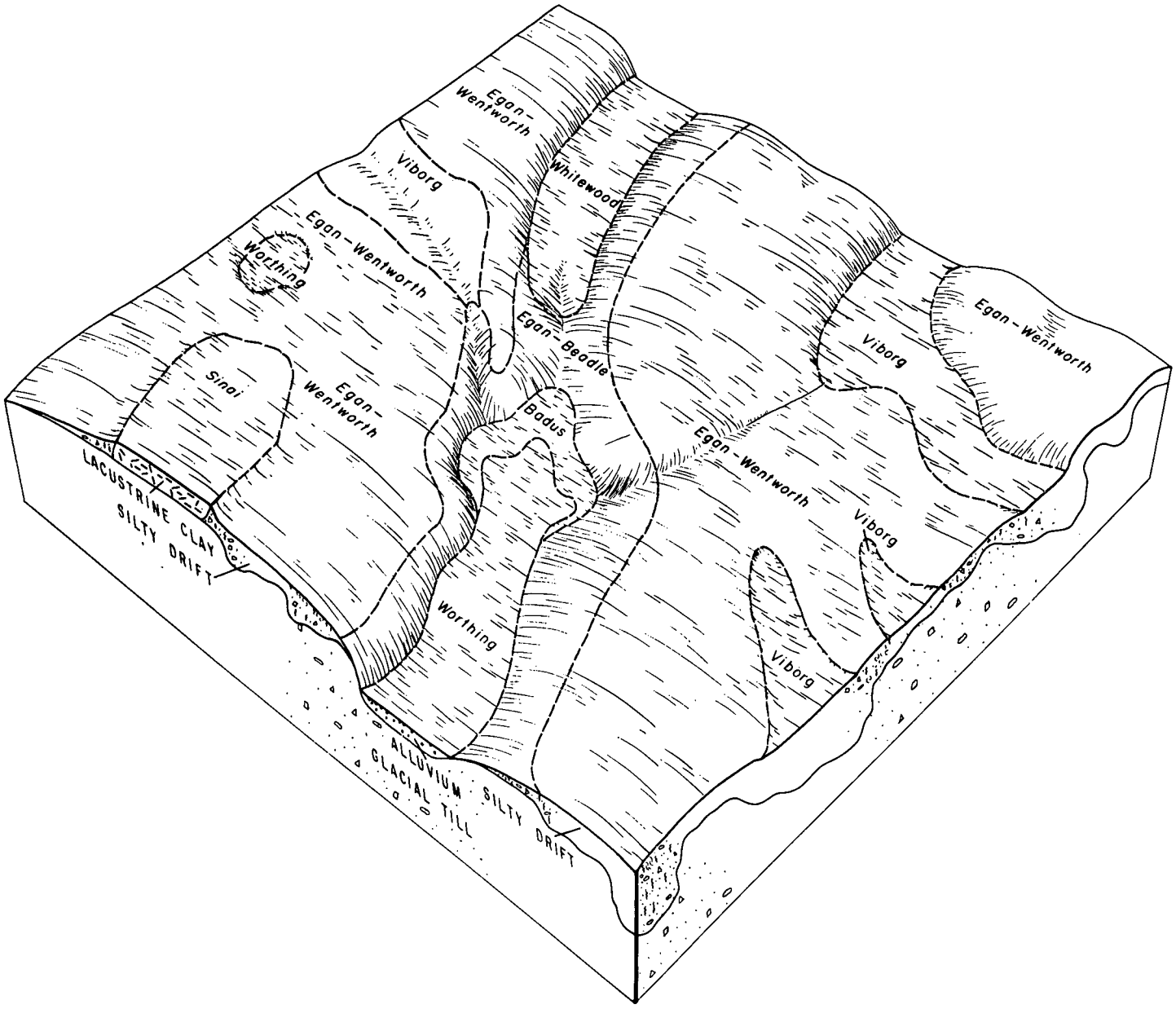

***Figure 4.*—Relationship of soils to topography and underlying materials in the Egan-Wentworth association.**

The underlying material is calcareous, pale-brown silt loam. Moody soils have long, smooth slopes. Nora soils have a dark-gray and dark grayish-brown silt loam surface layer and a very friable, brown silt loam subsoil that becomes pale brown and calcareous in its lower part. The underlying material is calcareous, pale-brown silt loam. The surface layer and subsoil of Nora soils are thinner than those of the Moody soils. Nora soils are calcareous at a depth of less than 30 inches and are on the convex upper part of the slopes.

The less extensive soils in the association are Crofton soils on knoll tops and upper side slopes; Henkin soils in scattered pockets of sandy material; and Trent and Whitewood soils in swales.

Nearly all of this association is cultivated. It is well suited to corn, small grain, soybeans, alfalfa, and tame grasses. These soils are good for cropland, but they are susceptible to erosion. Control of erosion is a management need. Grassed waterways require careful management in order to prevent gullies from forming.

9. Ethan-Clarno-Betts association

Rolling to steep, well-drained to excessively drained, loamy soils formed in glacial till; on uplands

This association is in the southwestern part of the county. It consists of rolling to steep side slopes along the East Fork of the Vermillion River. There are scattered

Figure 5.—**Terraced landscape in the Egan-Wentworth association.**

boulders, stones, and pockets of gravel throughout the area.

This association makes up about 2 percent of the county. It is about 38 percent Ethan soils, 32 percent Clarno soils, 10 percent Betts soils; and 20 percent less extensive soils.

Ethan soils have a surface layer of dark grayish-brown loam and a subsoil of friable, dark grayish-brown clay loam. The underlying light brownish-gray clay loam is at a depth of 12 inches. The soil is calcareous at or near the surface. Ethan soils are on the upper part of side slopes. Clarno soils have a surface layer of dark-gray loam and a subsoil of friable, grayish-brown clay loam that is thicker than that of the Ethan soils. Clarno soils are on the lower part of side slopes. Betts soils have a thin, dark grayish-brown loam surface layer and grayish-brown and light grayish-brown loam underlying material. Betts soils are on steep slopes and are excessively drained.

Less extensive soils in the association are Davis soils on foot slopes and alluvial fans; Talmo soils on well-rounded, gravelly knobs and ridges; and Tetonka soils in depressions.

Most of this association is in pasture. It contains the most extensive areas of native grasses in the county. Many of the areas are too steep or too stony to be cultivated. Control of erosion by maintaining a good grass cover is the main management need.

Descriptions of the Soils

In this section the soil series and mapping units in this county are described. The approximate acreage and proportionate extent of each mapping unit are given in table 1.

The soils of each series are first described as a group. Important features common to all the soils of the series are listed, and the position of the soils on the landscape is given. Each series description has a short narrative description of a representative profile and a much more detailed description of the same profile, from which highly technical interpretations can be made. Following the profile is a brief statement of the range of characteristics of the soils in the series as mapped in this county. Comparisons are made with other soils that either are located nearby or are generally similar to the soils of the series being described.

Each soil, or mapping unit, in the series is next described. Individual soils are delineated on the map and identified by symbols. Generally these descriptions tell how the profile of the soil differs from that described as representative of the series. They also tell about the use and suitability of the soil described and something about management needs.

For full information about any one mapping unit, it is necessary to read the description of the soil series as well as the description of the mapping unit. General information about the broad patterns of soils in the county is given in the section "General Soil Map." Unless otherwise indicated, the color names and color symbols given are for dry soil.

The names and delineations of some soils in this county are unlike those appearing in recently published surveys of adjacent counties. This is because of changes in the concept of soil series in the application of the soil classification system.

Badus Series

The Badus series consists of deep, somewhat poorly drained and poorly drained, nearly level, silty soils that are calcareous. These soils formed in alluvium over glacial till and are on uplands in broad swales, in small, flat-bottomed depressions, and on rims around larger depressions.

In a representative profile, the surface layer is dark-gray silty clay loam about 14 inches thick. The subsoil is dark-gray silty clay loam about 20 inches thick. It is slightly hard when dry and friable when moist. There are spots and streaks of lime, gypsum, and other salts in the subsoil and underlying material. The underlying material consists of gray and light olive-gray silty clay loam that is mottled with yellowish brown and strong brown.

The organic-matter content is high. Fertility is medium, although available phosphorus is low in most places. Lime content is high. Surface runoff is slow, permeability is moderately slow, and available water capacity is moderate to high.

Badus soils are used for corn, small grain, hay, and pasture. Intensity of use depends on drainage improvement measures. The native vegetation consists of tall and mid grasses.

Representative profile of Badus silty clay loam, in a cultivated field, 350 south and 240 feet west of the northeast corner of sec. 16, T. 106 N., R. 51 W.

Ap—0 to 7 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky when wet; common fine lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

A12—7 to 14 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) when moist; weak, coarse and medium, subangular blocky structure and weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky when wet; common fine lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

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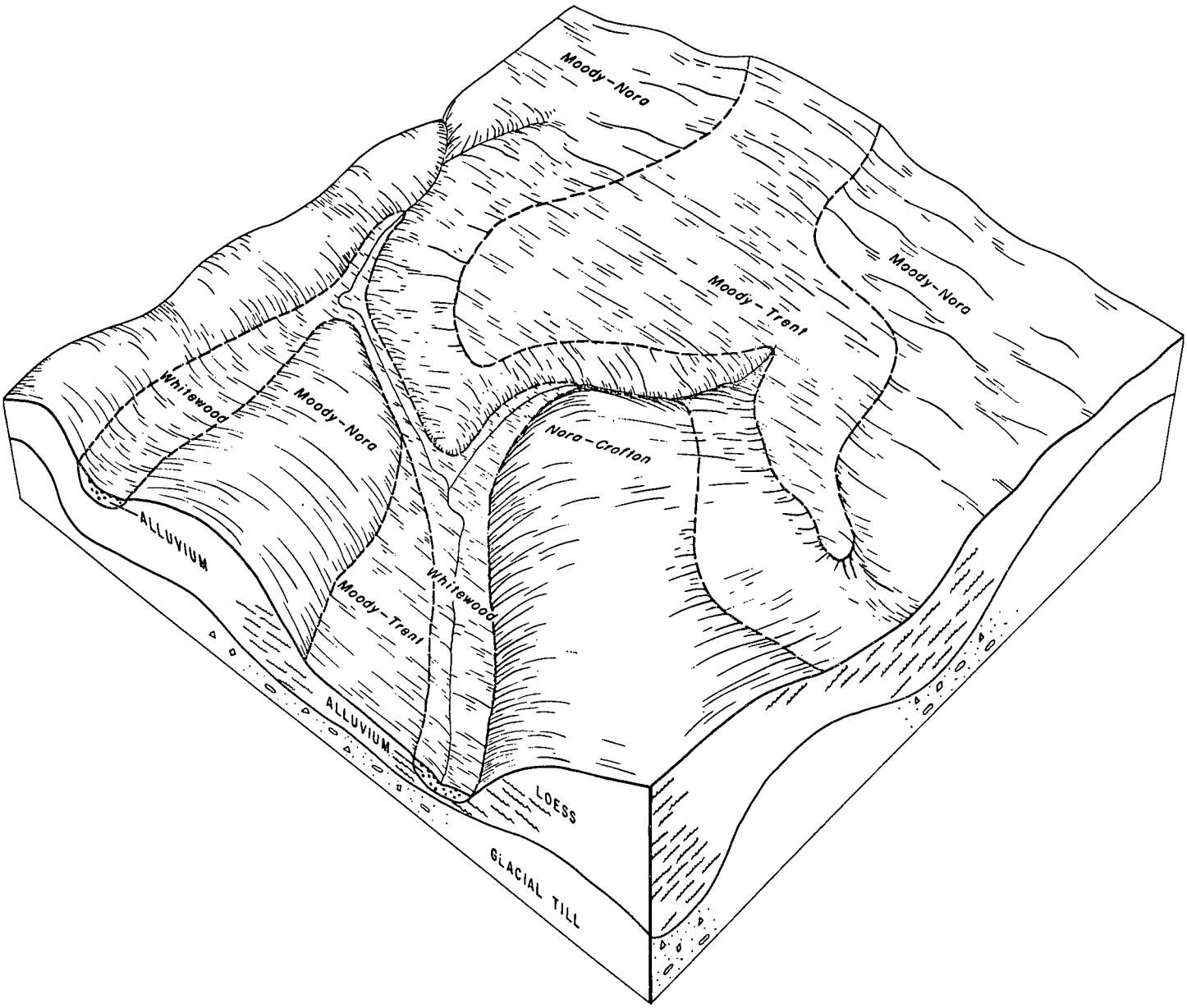

Figure 6.—**Relationship of soils to topography and underlying materials in the Moody-Nora association.**

B21cacs—14 to 25 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) when moist; weak, very coarse and coarse, subangular blocky structure; slightly hard when dry, friable when moist, sticky when wet; many fine gypsum crystals; common fine lime segregations; calcareous; mildly alkaline; gradual, wavy boundary.

B22cacs—25 to 34 inches, dark-gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) when moist; weak, very coarse and coarse, subangular blocky structure; slightly hard when dry, friable when moist, sticky when wet; many fine gypsum crystals; few fine lime segregations; calcareous; mildly alkaline; clear, wavy boundary.

C1gca—34 to 50 nches, gray (5Y 6/1) and light olive-gray (5Y.6/2) silty clay loam, gray (5Y 5/1) and olive gray (5Y 5/2) when moist; common, fine, distinct mottles of yellowish brown (10YR 5/6) when moist; weak, very coarse and coarse, subangular blocky structure; hard when dry, friable when moist, sticky when wet; few fine and medium lime segregations; calcareous; moderately alkaline; clear, wavy boundary.

C2gca—50 to 60 inches, gray (5Y 6/1) silty clay loam, olive gray (5Y 5/2) when moist; many, fine and medium, distinct mottles of yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) when moist; massive; hard when dry, friable when moist, sticky when wet; common, fine and medium, distinct iron concretions; common fine and medium lime segregations; calcareous; moderately alkaline.

The A horizon ranges from 12 to 24 inches in thickness, from dark gray to very dark gray in color, and from mildly alkaline to moderately alkaline in reaction. The B horizon

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent	Soil	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Badus silty clay loam	12,055	3.2	Graceville silty clay loam	1,735	0.5
Baltic silty clay loam	3,339	.9	Henkin loam, 0 to 3 percent slopes	104	(1)
Beadle clay loam, 0 to 2 percent slopes	465	.1	Henkin loam, 3 to 9 percent slopes	1,857	.5
Beadle clay loam, 2 to 6 percent slopes	1,511	.4	Houdek loam, 2 to 6 percent slopes	1,825	.5
Beadle clay loam, 6 to 9 percent slopes	342	(1)	Houdek-Prosper loams, 0 to 3 percent slopes	4,258	1.1
Clarno loam, 0 to 2 percent slopes	1,074	.3	Lamo silty clay loam	8,946	2.4
Clarno loam, 2 to 6 percent slopes	9,306	2.5	Moody-Nora complex, 2 to 6 percent slopes	1,473	.4
Clarno loam, 6 to 9 percent slopes	607	.2	Moody-Trent silty clay loams, 0 to 2 percent slopes	214	(1)
Clarno-Ethan loams, 2 to 6 percent slopes	932	.3	Nora-Crofton silt loams, 6 to 9 percent slopes	621	.2
Clarno-Ethan loams, 6 to 9 percent slopes	2,295	.6	Prosper loam, 0 to 2 percent slopes	2,457	.7
Clarno-Ethan loams, 9 to 16 percent slopes	9,017	2.4	Rauville silty clay loam	3,817	1.0
Davis loam	932	.3	Sandy lake beaches	153	(1)
Delmont-Talmo loams, 2 to 6 percent slopes	1,174	.3	Sinai silty clay, 0 to 2 percent slopes	17,617	4.7
Delmont-Talmo loams, 6 to 9 percent slopes	518	.1	Sinai silty clay loam, 2 to 6 percent slopes	10,910	2.9
Dempster silt loam, 0 to 2 percent slopes	5,035	1.3	Stickney-Tetonka complex, 0 to 2 percent slopes	2,457	.7
Dempster silt loam, 2 to 6 percent slopes	4,386	1.2	Talmo-Delmont loams, 6 to 21 percent slopes	1,205	.3
Dempster-Delmont complex, 6 to 9 percent slopes	418	.1	Tetonka silt loam	3,137	.8
Egan silty clay loam, 6 to 9 percent slopes	4,371	1.2	Viborg silty clay loam, 0 to 2 percent slopes	27,555	7.4
Egan-Beadle complex, 0 to 2 percent slopes	868	.2	Viborg-Egan silty clay loams, 2 to 6 percent slopes	4,646	1.2
Egan-Beadle complex, 2 to 6 percent slopes	30,455	8.2	Volga silty clay loam	461	.1
Egan-Beadle complex, 6 to 9 percent slopes	10,621	2.9	Wentworth-Egan silty clay loams, 0 to 2 percent slopes	4,264	1.1
Egan-Ethan complex, 2 to 6 percent slopes	1,421	.4	Whitewood silty clay loam	20,765	5.6
Egan-Ethan complex, 6 to 9 percent slopes, eroded	19,019	5.1	Worthing silty clay loam	19,699	5.3
Egan-Viborg silty clay loams, 0 to 3 percent slopes	18,331	5.0	Marsh (indicated by symbol on soil map)	9,076	2.4
Egan-Wentworth silty clay loams, 2 to 6 percent slopes	67,483	18.1	Open water (indicated by symbol on soil map)	767	.2
Enet loam, 0 to 2 percent slopes	706	.2	Gravel pits (indicated by symbol on soil map)	327	(1)
Ethan-Betts loams, 21 to 40 percent slopes	1,122	.3	Water areas greater than 40 acres in size	9,920	2.7
Ethan-Clarno loams, 16 to 21 percent slopes	1,365	.4			
Ethan-Clarno stony complex, 6 to 25 percent slopes	2,015	.5	Total	372,480	100.0
Ethan-Davis stony complex, 3 to 21 percent slopes	1,031	.3			

[1] Less than 0.1 percent.

ranges from 16 to 25 inches in thickness. In places gley colors and mottles are in the lower part of the B horizon. The C horizon generally becomes increasingly mottled and less calcareous with depth. Texture of the C horizon commonly is silty clay loam or silty clay, but in places these materials change abruptly to clay loam glacial till at a depth below 36 inches.

Badus soils have a less clayey B horizon than the more poorly drained Baltic and Worthing soils. They are more calcareous than Whitewood and Worthing soils. Badus soils formed in material of more uniform texture than Lamo soils, which formed in stratified alluvium.

Badus silty clay loam (0 to 2 percent slopes) (Ba).—This soil is in broad upland swales, in small, flat-bottomed depressions, and on rims around larger depressions. In a few areas the subsoil is more clayey than that in the representative profile.

Included in mapping were areas of Worthing and Whitewood soils. The Worthing soils occur as small, circular, low spots. Inclusions ordinarily make up about 12 percent of a given area of this mapping unit.

Wetness from flooding is the main limitation to farming. If adequately drained, this soil is well suited to corn, small grain, and alfalfa. Management practices that improve tilth and supply plant nutrients to the soil are needed. (Capability unit IIw–1, windbreak group 1, pasture group A, drained, and B, undrained)

Baltic Series

The Baltic series consists of deep, poorly drained to very poorly drained, level, calcareous, silty soils that have a clayey subsoil. These soils formed in alluvium washed from adjacent areas. They are on large flats and in closed depressions throughout the county.

In a representative profile, the surface layer is dark-gray silty clay loam about 11 inches thick. The subsoil is dark-gray silty clay about 24 inches thick. It is hard when dry and firm when moist. The underlying material consists of gray, calcareous silty clay. It is mottled with olive and dark brown and has spots of lime and gypsum.

The organic-matter content is high, and fertility is medium. Lime content is high. Surface runoff is ponded, permeability is slow, and the available water capacity is moderate to high. A water table is commonly at a depth of 4 to 6 feet.

Baltic soils are well suited to hay. Native vegetation includes marsh grasses, sedges, and reeds. If adequately drained, Baltic soils can be cultivated. Undrained areas can be farmed only during dry years.

Representative profile of Baltic silty clay loam, in a cultivated field, 1,245 feet east and 1,815 feet south of the northwest corner of sec. 14, T. 107 N., R. 53 W.

Ap—0 to 5 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky when wet; common small snail shells; calcareous; moderately alkaline; abrupt, smooth boundary.

A12—5 to 11 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) when moist; few, fine, distinct mottles of dark brown (7.5YR 4/4) when moist; weak, fine, subangular blocky structure parting to weak, fine and very fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common small snail shells; calcareous; moderately alkaline; gradual, wavy boundary.

B21—11 to 21 inches, dark-gray (10YR 4/1) silty clay, black (10YR 2/1) when moist; few, fine, distinct mottles of dark brown (7.5YR 4/4) when moist; weak, coarse and medium, subangular blocky structure parting to weak, fine and very fine, subangular blocky structure; hard when dry, firm when moist, sticky and plastic when wet; common small snail shells; calcareous; moderately alkaline; gradual, wavy boundary.

B22—21 to 35 inches, dark-gray (10YR 4/1) silty clay, black (10YR 2/1) when moist; few, fine, faint mottles of olive (5Y 5/3) when moist; moderate, medium and fine, blocky structure; hard when dry, firm when moist, sticky and plastic when wet; calcareous; moderately alkaline; gradual, wavy boundary.

C1cs—35 to 56 inches, gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) when moist; few, fine, faint mottles of olive (5Y 5/3) when moist; weak, medium and fine, subangular blocky structure; hard when dry, firm when moist, sticky and slightly plastic when wet; many fine gypsum crystals; few medium and fine lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C2g—56 to 60 inches, gray (5Y 5/1) silty clay, very dark gray (5Y 3/1) when moist; many, fine and medium, distinct mottles of olive (5Y 4/3) when moist and few, fine and medium, distinct mottles of dark brown (10YR 4/3) when moist; massive; very hard when dry, firm when moist, sticky and plastic when wet; few fine gypsum crystals; few fine lime segregations; calcareous; moderately alkaline.

The A horizon ranges from 8 to 18 inches in thickness and from silty clay loam to silty clay in texture. In places there is a mat of undecomposed organic material above the A horizon. The B horizon is black to very dark gray when moist and ranges from 20 to 40 inches in thickness. Gypsum salts in the B and C horizons range from few to many crystals and nests. Texture of the C horizon is silty clay loam, silty clay, and clay loam.

Baltic soils are more calcareous than Worthing soils. They are more poorly drained and have a more clayey B horizon than Badus, Lamo, and Whitewood soils.

Baltic silty clay loam (0 to 1 percent slopes) (Bc).—This soil is in large, flat, closed depressions.

Included in mapping were small areas of Badus soils that occur on narrow rims around the outer edges of the depressions. Also included were small marshy spots in low areas. Inclusions make up less than 10 percent of a given area of this mapping unit.

Wetness is the major limitation of this soil. Unless it is drained, it is better suited to hay than to other crops. If adequately drained, it is suited to cultivation. Improvement of tilth and fertility is also a management need. (Capability unit IIIw–2, windbreak group 10, pasture group A, drained, and B, undrained)

Beadle Series

The Beadle series consists of deep, well-drained, nearly level to undulating, loamy soils that have a clayey subsoil. These soils formed in glacial till on uplands.

In a representative profile, the surface layer is dark-gray clay loam about 6 inches thick. The subsoil, about 30 inches thick, is clay loam that contains more clay than the surface layer. It is dark grayish brown in the upper part, grayish brown in the middle part, and light brownish gray in the lower part. It is hard when dry and firm when moist. There are spots of lime in the lower part of the subsoil that extend into the underlying material. The underlying material is calcareous, light brownish-gray and pale-brown clay loam.

Beadle soils are medium in fertility and moderate in organic-matter content. Surface runoff is slow to medium, permeability is moderately slow, and the available water capacity is moderate to high. Water erosion is a hazard in sloping areas.

Most areas of these soils are cultivated. Corn, small grain, and alfalfa are suitable crops.

Representative profile of Beadle clay loam, 6 to 9 percent slopes, in a cultivated field, 282 feet south and 525 feet west of the northeast corner of sec. 6, T. 107 N., R. 52 W.

Ap—0 to 6 inches, dark-gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) when moist; weak, fine, granular structure; hard when dry, friable when moist; neutral; abrupt, smooth boundary.

B21t—6 to 14 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (2.5Y 3/2) when moist; moderate, medium, prismatic structure parting to moderate, coarse and strong, medium, blocky structure; hard when dry, firm when moist; moderately thick, continuous clay films; neutral; clear, wavy boundary.

B22t—14 to 22 inches, grayish-brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) when moist; moderate, medium, prismatic structure parting to strong, coarse and medium, blocky structure; hard when dry, firm when moist; thin, continuous clay films and moderately thick, patchy clay films; common, medium, distinct lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

B3ca—22 to 36 inches, light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) when moist; strong, coarse and medium, blocky structure parting to strong, fine, blocky and subangular blocky structure; hard when dry, firm when moist; thin, continuous clay films and moderately thick, patchy clay films; many, medium, distinct lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C1—36 to 42 inches, light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) to light olive brown (2.5Y 5/4) when moist; massive; hard when dry, firm when moist; common, fine, distinct lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C2—42 to 50 inches, light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) when moist; massive; hard when dry, firm when moist; few, fine, distinct lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C3—50 to 60 inches, pale-brown (10YR 6/3) clay loam, dark grayish brown (2.5Y 4/2) when moist; massive; hard when dry, firm when moist; few medium and many fine, distinct iron concretions; few, fine, distinct lime segregations; calcareous; moderately alkaline.

The A horizon ranges from 6 to 9 inches in thickness and is silty clay loam, loam, and clay loam in texture. The B horizon ranges from 15 to 30 inches in thickness. Clay content is more than 35 percent. Structure of the B horizon ranges from moderate to strong prismatic and blocky. The C horizon generally is clay loam in texture, but it ranges from loam to clay. In places the lower part of the C horizon

is very pale brown. Depth to lime ranges from 12 to 26 inches.

Beadle soils have a more clayey and stronger structured B horizon than Houdek and Clarno soils. They have a thinner A horizon and are better drained than Prosper soils.

Beadle clay loam, 0 to 2 percent slopes (BdA).—This soil is on uplands in the southwestern part of the county. Areas of this soil are less than 20 acres in size. The surface layer is slightly thicker than that of the profile described as representative for the series. Depth to lime ranges from 18 to 26 inches.

Included in mapping were areas of Egan, Prosper, and Viborg soils. The Egan and Viborg soils are intermingled with this Beadle soil in areas east of the East Fork of the Vermillion River. The Prosper soils are in areas west of the river. These inclusions generally make up less than 15 percent of any given area of this mapping unit.

Most of this soil is cultivated. Runoff is slow, and erosion is not a hazard. Improvement of tilth and maintenance of organic-matter content and fertility are management needs. (Capability unit IIs–1, windbreak group 4, pasture group E)

Beadle clay loam, 2 to 6 percent slopes (BdB).—This soil is on uplands in all parts of the county. Areas of this soil are small and irregularly shaped. Depth to lime ranges from 18 to 26 inches.

Included in mapping, west of the East Fork of the Vermillion River, were areas of Clarno, Ethan, and Prosper soils. The Clarno and Ethan soils are on the upper part of the slopes. The Prosper soils are in slightly depressional areas. Also included, east of the river, were areas of Egan and Viborg soils. The Egan soils occur in an erratic pattern, and the Viborg soils are in swales. Inclusions make up less than 10 percent of any given area of this mapping unit.

Most areas of this soil are cultivated. The main management need is control of water erosion. Because of the short, irregular slopes and the small size of the areas, mechanical conservation practices are generally difficult to apply. Maintenance of organic-matter content and fertility and improvement of tilth are other management needs. (Capability unit IIIe–3, windbreak group 4, pasture group E)

Beadle clay loam, 6 to 9 percent slopes (BdC).—This undulating soil is on uplands in all parts of the county. The areas of this soil are less than 15 acres in size and are generally narrow. Slopes are short and irregular. This soil has the profile described as representative for the series.

Included in mapping, west of the East Fork of the Vermillion River, were areas of Clarno and Ethan soils. These soils are on the upper part of the slopes. Also included, east of the river, were areas of Egan and Ethan soils. Inclusions make up less than 10 percent of any given area of this mapping unit.

Most of this soil is cultivated. Control of erosion is the main management need. Mechanical conservation practices are difficult to apply. (Capability unit IIIe–5, windbreak group 4, pasture group E)

Betts Series

The Betts series consists of deep, excessively drained, steep, loamy soils that have a thin surface layer. These soils formed in calcareous glacial till. They are on uplands and occur mainly as breaks along the East Fork of the Vermillion River. Betts soils in Lake County are mapped only in a complex with Ethan soils.

In a representative profile, the surface layer is calcareous, dark grayish-brown loam about 4 inches thick. Below the surface layer is slightly weathered, grayish-brown and light brownish-gray, calcareous clay loam till.

Betts soils have low organic-matter content and natural fertility. Surface runoff is rapid, permeability is moderate to moderately slow, and the available water capacity is high. Water erosion is a hazard.

The principal use of these soils is for native pasture. Native grass species include needle-and-thread, blue grama, buffalograss, little bluestem, and side-oats grama. Because of the steep slopes, these soils are not suitable for cultivation or for hayland.

Representative profile of a Betts loam, in an area of Ethan-Betts loams, 21 to 40 percent slopes, in a native pasture, 465 feet south and 666 feet west of the northeast corner of sec. 19, T. 105 N., R. 53 W.

A1—0 to 4 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) when moist; weak, medium and fine, subangular blocky structure and weak, fine, granular structure; soft when dry, friable when moist, slightly sticky when wet; calcareous; mildly alkaline; clear, wavy boundary.

C1ca—4 to 17 inches, grayish-brown (10YR 5/2) clay loam, dark brown (10YR 4/3) when moist; weak, coarse, prismatic structure parting to weak, very coarse and coarse, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; few, fine, distinct iron stains of yellowish brown (10YR 5/8) and yellowish red (5YR 4/8) when moist; common, fine, distinct lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C2ca—17 to 29 inches, grayish-brown (10YR 5/2) clay loam, dark brown (10YR 4/3) when moist; weak, very coarse, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; common, fine and medium, distinct iron stains of yellowish brown (10YR 5/8) and few, fine, distinct iron stains of yellowish red (5YR 4/8) when moist; common, fine and medium, distinct lime segregations; calcareous; moderately alkaline; clear, wavy boundary.

C3ca—29 to 39 inches, light brownish-gray (10YR 6/2) clay loam, brown (10YR 5/3) when moist; weak, coarse, medium, and fine, blocky structure; hard when dry, firm when moist, sticky when wet; many, fine and medium, distinct iron stains of yellowish brown (10YR 5/8) and few, fine, distinct iron stains of yellowish red (5YR 4/8) when moist; common, fine and medium, distinct lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C4—39 to 60 inches, light brownish-gray (10YR 6/2) clay loam, yellowish brown (10YR 5/4) when moist; massive; hard when dry, firm when moist, sticky when wet; common, fine and medium, distinct iron stains of yellowish brown (10YR 5/8) and common, fine, distinct iron stains of yellowish red (5YR 4/8) when moist; few, fine, distinct lime segregations; calcareous; moderately alkaline.

The A horizon ranges from 2 to 5 inches in thickness, from grayish brown to dark grayish brown in color when dry, and from very dark gray to very dark brown in color when moist. The A horizon is absent where small areas have sloughed or because of erosion. Pebbles and stones on the surface and in the profile differ in size and amount. The C horizon is glacial till that ranges from friable to firm in consistence when moist.

Betts soils have a thinner A horizon than the Ethan soils with which they occur.

Clarno Series

The Clarno series consists of deep, well-drained, nearly level to hilly, loamy soils on uplands. These soils formed in friable glacial till.

In a representative profile, the surface layer is dark-gray loam about 6 inches thick. The subsoil is clay loam about 19 inches thick. It is grayish brown in the upper part and light brownish gray in the lower part. It is slightly hard when dry and friable when moist. There are spots of lime in the lower part that extend into the underlying material. The underlying material consists of calcareous, light brownish-gray to light-gray clay loam glacial till.

Clarno soils have moderate organic-matter content and medium fertility. Surface runoff is slow to medium, and permeability is moderate in the subsoil and moderate to moderately slow in the underlying material. The available water capacity is high.

Most areas of these soils are farmed. Corn, oats, soybeans, and alfalfa are the main crops grown. Small areas are in grass and are used for grazing and for hay.

Representative profile of Clarno loam, 2 to 6 percent slopes, in a cultivated field, 450 feet west and 540 feet north of the southeast corner of sec. 29, T. 106 N., R. 54 W.

Ap—0 to 6 inches, dark-gray (10YR 4/1) loam, black (10YR 2/1) when moist, dark grayish brown (10YR 4/2) and very dark gray (10YR 3/1) when moist and crushed; weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky when wet; neutral; abrupt, smooth boundary.

B21—6 to 10 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) and with tongues of very dark gray (10YR 3/1) when moist; weak, medium, prismatic structure parting to weak, coarse and medium, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; thin, patchy clay films on vertical ped faces; neutral; gradual, wavy boundary.

B22—10 to 15 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; weak, coarse and medium, prismatic structure parting to weak, coarse and medium, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; thin, patchy clay films on vertical ped faces; neutral; clear, wavy boundary.

B3ca—15 to 25 inches, light brownish-gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) when moist; weak, very coarse and coarse, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; common, fine and medium, distinct lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C1—25 to 33 inches, light brownish-gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) when moist; common, fine, distinct mottles of gray (5Y 5/1) when moist; massive; hard when dry, friable when moist, slightly sticky when wet; few, fine, distinct iron stains of yellowish red (5YR 4/8) and strong brown (7.5YR 5/6) when moist; few, fine, distinct lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C2—33 to 47 inches, light brownish-gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) when moist; common, fine and medium, distinct mottles of gray (5Y 5/1) when moist; massive; very hard when dry, friable when moist, slightly sticky when wet; few fine to medium shale chips; few to common, fine, distinct iron stains of yellowish red (5YR 4/8) and strong brown (7.5YR 5/6) when moist; few, fine, distinct lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C3—47 to 60 inches, light-gray (2.5Y 7/2) clay loam, grayish brown (2.5Y 5/2) when moist; common, fine and medium, distinct mottles of gray (5Y 6/1) when moist; massive; very hard when dry, friable when moist, slightly sticky when wet; many to few, fine and common, distinct iron stains of yellowish brown (10YR 5/6), strong brown (7.5YR 5/6), and red (2.5YR 5/6) when moist; few, fine, distinct iron concretions; few, fine, distinct lime segregations; calcareous; moderately alkaline.

The A horizon ranges from 6 to 8 inches in thickness and from dark gray to dark grayish brown in color. The B horizon ranges from loam to clay loam in texture and from 14 to 28 inches in thickness. Clay content of the B horizon is less than 30 percent and is only slightly more than in the A horizon. Depth to lime ranges from 12 to 20 inches. The C horizon ranges from light brownish gray and light gray to light yellowish gray in color. Texture of the C horizon ranges from loam to clay loam.

Clarno soils have less clay in the B horizon than Beadle soils. They have a thicker B horizon and are deeper to lime than the nearby Ethan soils. Clarno soils have less increase in clay content from the A to B horizon than Houdek soils. They are better drained and have a thinner A horizon than Prosper soils.

Clarno loam, 0 to 2 percent slopes (CaA).—This nearly level soil is on uplands west of the East Fork of the Vermillion River. The profile is similar to that described as representative for the series, except that lime is at a slightly greater depth.

Included in mapping were areas of Beadle and Prosper soils. The Prosper soils are in swales. Inclusions make up 10 to 15 percent of a given area of this mapping unit.

Most of this soil is cultivated. Maintenance of fertility and tilth is the main management need. (Capability unit I–1, windbreak group 3, pasture group F)

Clarno loam, 2 to 6 percent slopes (CaB).—This gently undulating soil is on uplands west of the East Fork of the Vermillion River. It has the profile described as representative for the series.

Included in mapping were areas of Ethan and Prosper soils. The Ethan soils are on the crests of slopes, and the Prosper soils are in the swales. Inclusions make up about 12 percent of a given area of this mapping unit.

Most of this soil is cultivated. Runoff is medium, and water erosion is a hazard. Management needs include control of erosion and maintenance of fertility. Mechanical conservation practices to control erosion are needed on the longer slopes. (Capability unit IIe–2, windbreak group 3, pasture group F)

Clarno loam, 6 to 9 percent slopes (CaC).—This undulating soil is on uplands in the southwestern part of the county. The surface layer and subsoil are slightly thinner than those of the profile described as representative for the series. The depth to lime ranges from 12 to 16 inches.

Included in mapping were areas of Beadle, Ethan, and Prosper soils. The Beadle soils are on the lower slopes and along drainageways. The Ethan soils are on the crests of short slopes, and the Prosper soils are in the swales. Inclusions make up about 15 percent of a given area of this mapping unit.

Most areas of this soil are cultivated, but some areas are in pasture. Control of erosion and maintenance of fertility are management needs. (Capability unit IIIe–2, windbreak group 3, pasture group F)

Clarno-Ethan loams, 2 to 6 percent slopes (CeB).—Clarno soils make up 50 to 70 percent of this complex, and Ethan soils make up 20 to 30 percent. These soils are

on uplands west of the East Fork of the Vermillion River. Areas of these soils are marked by short, convex slopes between narrow swales. Clarno soils are on the mid and lower side slopes and have the profile described as representative for their series. Ethan soils, which are on the upper slopes and ridgetops, are somewhat deeper to lime than the soil described as representative for the series. In places the Ethan soils are eroded and are so mixed with the underlying material that they are easily distinguished by their light color.

Included in mapping were areas of Prosper soils in the narrow swales. They make up about 10 to 20 percent of a given area of this mapping unit.

Most areas of this complex are cultivated. Small areas are in grass and are used for hay or pasture. Control of erosion and maintenance of organic-matter content and fertility are management needs. Because of the short, irregular slopes, mechanical conservation practices are difficult to apply. (Capability unit IIe–2, windbreak group 3, pasture group F)

Clarno-Ethan loams, 6 to 9 percent slopes (CeC).—Clarno soils make up 50 to 70 percent of this complex, and Ethan soils make up 20 to 30 percent. These undulating soils are on uplands in the western part of the county. Slopes are short, convex, and irregular. Clarno soils are on the side slopes and have a thinner surface layer than that of the profile described as representative for the series. Ethan soils are on the upper side slopes and ridgetops. They commonly are eroded and are lighter in color than the soil described as representative for the series (fig. 7).

Included in mapping were areas of Beadle, Betts, and Prosper soils. Beadle soils are on the lower slopes and along drainageways, Betts soils are on some of the ridgetops, and Prosper soils are in swales. Prosper soils are the most extensive soils among the inclusions, which ordinarily make up less than 15 percent of any given area of this mapping unit.

Most areas of these soils are farmed to row crops, small grain, alfalfa, and tame pastures. A few areas are in native grass. The main management need is control of water erosion. Because of the irregular slopes, mechanical conservation practices generally are difficult to apply. The alternative is to grow grass in the rotation for longer periods of time. (Clarno part is in capability unit IIIe–2; Ethan part is in capability unit IVe–4; both soils are in windbreak group 3 and pasture group F)

Clarno-Ethan loams, 9 to 16 percent slopes (CeD).—Clarno soils make up 40 to 60 percent of this complex, and Ethan soils make up 30 to 40 percent. These rolling soils are on uplands, mainly along the East Fork of the Vermillion River. The Clarno soils are on the longer and smoother side slopes and have a slightly thinner surface layer and subsoil than those of the profile described as representative for the series. Ethan soils are on the upper slopes and ridgetops. They have the profile described as representative for the series.

Included in mapping were areas of Davis, Tetonka, and Whitewood soils. Davis soils are on toe slopes and in swales, Tetonka soils are in depressions, and Whitewood soils are in the more deeply entrenched and more poorly drained swales. The Davis soils are the most extensive inclusions, which make up 10 to 20 percent of any given area of this mapping unit.

This complex is used for crops, hay, and pasture. Runoff is medium to rapid. The main management need is control of water erosion. In cultivated areas, mechanical conservation practices are needed to control erosion. If such practices are not feasible, this complex is better suited to pasture or hay than to other crops. (Clarno part is in capability unit IVe–2 and windbreak group 3; Ethan part is in capability unit VIe–1 and windbreak group 10; both soils are in pasture group F)

Figure 7.—Area of Clarno-Ethan loams, 6 to 9 percent slopes.

Crofton Series

The Crofton series consists of deep, well-drained, sloping, silty soils on uplands in the extreme southeastern corner of the county. They formed in calcareous loess. Crofton soils in Lake County are mapped only in a complex with Nora soils.

In a representative profile, the surface layer is calcareous, grayish-brown silt loam about 6 inches thick. Below the surface layer is light brownish-gray and light-gray silt loam. It is slightly hard when dry and very friable when moist.

Crofton soils have low organic-matter content and fertility. Surface runoff is medium, permeability is moderate, and the available water capacity is high. These soils are susceptible to water erosion and soil blowing.

Most areas of these soils are cultivated, but some areas are in pasture. Corn, oats, soybeans, and alfalfa are the main crops grown.

Representative profile of a Crofton silt loam from an area of Nora-Crofton silt loams, 6 to 9 percent slopes, in a cultivated field, 1,128 feet east and 360 feet north of the southwest corner of sec. 35, T. 105 N., R. 51 W.

Ap—0 to 6 inches, grayish-brown (2.5Y 5/2) silt loam, dark grayish brown (2.5Y 4/2) when moist; weak, fine, granular structure; slightly hard when dry, very

friable when moist, slightly sticky when wet; calcareous; moderately alkaline; abrupt, smooth boundary.

C1ca—6 to 20 inches, light brownish-gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) when moist; weak, very coarse, subangular blocky structure; slightly hard when dry, very friable when moist, slightly sticky when wet; common, medium iron concretions; many fine or medium, and few coarse lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C2—20 to 32 inches, light brownish-gray (2.5Y 6/2) silt loam, grayish brown (2.5Y 5/2) when moist; weak, very coarse, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; many, fine and medium, distinct iron stains of light olive brown (2.5Y 5/6) when moist; common, fine and medium iron concretions; common fine and few medium lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C3—32 to 45 inches, light-gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) when moist; massive; slightly hard when dry, friable when moist, slightly sticky when wet; many, fine and medium, distinct iron stains of light olive brown (2.5Y 5/6) when moist; common fine and medium iron concretions; few fine lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C4—45 to 60 inches, light-gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) when moist; massive; slightly hard when dry, friable when moist, slightly sticky when wet; many, fine and medium, distinct iron stains of light olive brown (2.5Y 5/6) and olive yellow (2.5Y 6/6) when moist; many medium iron concretions; calcareous; moderately alkaline.

The A horizon ranges from 4 to 6 inches in thickness and from dark grayish brown to grayish brown in color. In cultivated areas the A horizon has been removed by erosion or has been mixed with the C1ca horizon by plowing.

Crofton soils have a thinner A horizon than Moody soils. They lack the B horizon of the Moody and Nora soils and are calcareous at or near the surface.

Davis Series

The Davis series consists of deep, moderately well drained, nearly level to gently sloping, loamy soils in upland swales, on toe slopes, and on terrace fans. These soils formed in local alluvium. They occur mainly along the East Fork of the Vermillion River.

In a representative profile, the surface layer is very dark gray loam about 9 inches thick. The subsoil is about 37 inches thick. It is very dark gray and dark gray loam in the upper part, dark grayish-brown clay loam in the middle part, and pale-brown silty clay loam in the lower part. It is slightly hard to very hard when dry and friable when moist. There are lime concretions in the lower part that extend into the underlying material. The underlying material is calcareous, light brownish-gray and light-gray silty clay loam.

Davis soils have moderate organic-matter content and high fertility. Surface runoff is slow to medium, and permeability is moderate. Davis soils occasionally receive runoff from adjacent soils. The available water capacity is moderate to high.

Davis soils are mostly cultivated. Corn, small grain, alfalfa, and other crops common in the county are grown. Tall prairie grasses, smooth bromegrass, and bluegrass predominate in areas where these soils are used for pasture and hay.

Representative profile of Davis loam, in a native pasture, 690 feet west and 432 feet north of the southeast corner of sec. 10, T. 106 N., R. 54 W.

A1—0 to 9 inches, very dark gray (10YR 3/1) loam, black (10YR 2/1) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky when wet; neutral; gradual, wavy boundary.

B1—9 to 16 inches, very dark gray (10YR 3/1) loam, black (10YR 2/1) when moist, very dark brown (10YR 2/2) when moist and crushed; weak, coarse and medium, prismatic structure parting to weak, coarse, subangular blocky structure in turn parting to weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky when wet; neutral; gradual, wavy boundary.

B21—16 to 25 inches, dark-gray (10YR 4/1) loam, very dark gray (10YR 3/1) when moist, very dark grayish brown (10YR 3/2) when moist and crushed; weak, medium, prismatic structure parting to weak, coarse and medium, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; thin, patchy clay films on vertical ped faces; neutral; gradual, wavy boundary.

B22—25 to 40 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure parting to weak, coarse and medium, subangular blocky structure; hard when dry, friable when moist, slightly sticky when wet; thin, patchy clay films on vertical ped faces; neutral; clear, wavy boundary.

B3ca—40 to 46 inches, pale-brown (10YR 6/3) silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, very coarse and coarse, prismatic structure parting to weak, coarse and medium, subangular blocky structure; very hard when dry, friable when moist, slightly sticky when wet; thin, patchy clay films on vertical ped faces; common, fine, distinct lime segregations; calcareous; mildly alkaline; gradual, wavy boundary.

C1—46 to 52 inches, light brownish-gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) when moist; few, fine, faint mottles of gray (5Y 5/1) when moist; massive; very hard when dry, friable when moist, slightly sticky when wet; common, fine, distinct lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C2—52 to 60 inches, light-gray (2.5Y 7/2) silty clay loam, light yellowish brown (2.5Y 6/4) when moist; common, fine and medium, faint mottles of gray (5Y 6/1) and common, fine, distinct mottles of yellowish brown (10YR 5/6) when moist; massive; very hard when dry, friable when moist, slightly sticky when wet; few, fine, distinct lime segregations; calcareous; moderately alkaline.

The A horizon ranges from 7 to 18 inches in thickness and from dark gray to very dark gray in color. Texture is loam and silt loam. The B horizon ranges mainly from loam to clay loam in texture but has layers of silty clay loam. Grade of structure ranges from weak to moderate. The B horizon ranges from 23 to 46 inches in thickness. Moist colors of very dark grayish brown or darker extend to a depth of 30 inches or more. Depth to carbonates ranges from 30 to 50 inches. The C horizon ranges from light gray to grayish brown in color. In places it is stratified with coarser material and has buried dark-colored layers below a depth of 36 inches.

Davis soils are better drained and less silty than the calcareous Lamo soils that are on nearby bottom lands. They are less silty than Graceville, Trent, and Viborg soils.

Davis loam (0 to 2 percent slopes) (Da).—This soil is on terrace fans along the East Fork of the Vermillion River and in shallow valleys of intermittent streams. The profile is similar to the one described as representative for the series, except that in some areas there are buried dark-colored layers in the underlying material.

Included in mapping were small areas of Lamo soils in the slightly depressional areas. Also included were small areas of a soil that has a more clayey subsoil than this Davis soil. Inclusions make up less than 10 percent of any given area of this mapping unit.

Nearly all of this soil is cultivated. Row crops, small grain, and alfalfa are the main crops. In places runoff from adjacent soils causes a slight hazard of flooding. Maintenance of tilth and fertility is the main management need. (Capability unit I–1, windbreak group 1, pasture group K)

Delmont Series

The Delmont series consists of somewhat excessively drained, gently undulating to undulating, loamy soils that are shallow over stratified sand and gravel. These soils formed in alluvium and are on uplands and stream terraces.

In a representative profile, the surface layer is dark-gray loam about 6 inches thick. The loam subsoil is about 11 inches thick and is dark grayish brown in the upper part and grayish brown in the lower part. It is slightly hard when dry and friable when moist. The underlying material is brown, stratified sand and gravel (fig. 8).

Delmont soils have moderate organic-matter content and low fertility. Surface runoff is medium, permeability is moderately rapid, and the available water capacity is low.

Many areas are cultivated. Small grain is the main crop grown, but some corn is also grown. Other areas are used for tame hay or pasture.

Representative profile of a Delmont loam in an area of Delmont-Talmo loams, 2 to 6 percent slopes, in a cultivated field, 2,245 feet north and 880 feet east of the southwest corner of sec. 33, T. 106 N., R. 52 W.

Ap—0 to 6 inches, dark-gray (10YR 4/1) loam, black (10YR 2/1) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky when wet; neutral; abrupt, smooth boundary.

B21—6 to 14 inches, dark-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) when moist, dark grayish brown (10YR 4/2) when moist and crushed; weak, medium, prismatic structure parting to weak, coarse, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; neutral; clear, wavy boundary.

B22ca—14 to 17 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist, dark grayish brown (10YR 4/2) when moist and crushed; weak, medium, prismatic structure parting to weak, coarse, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; common, fine, distinct lime segregations; calcareous; moderately alkaline; abrupt, smooth boundary.

IIC—17 to 60 inches, brown (10YR 5/3) sand and gravel, dark brown (10YR 4/3) when moist; single grained; loose; calcareous; moderately alkaline.

The A horizon ranges from 4 to 7 inches in thickness and from dark gray to very dark gray in color. The surface layer is dominantly loam in texture, but it is silt loam in places. The B horizon ranges from 6 to 13 inches in thickness. Depth to sand and gravel ranges from 10 to 20 inches. There are common lime crusts on the gravel pebbles in the upper part of the IIC horizon in some profiles.

Delmont soils are deeper over sand and gravel than Talmo soils. They are more shallow over sand and gravel and have a thinner B horizon than Enet and Dempster soils. They are less silty than Dempster soils.

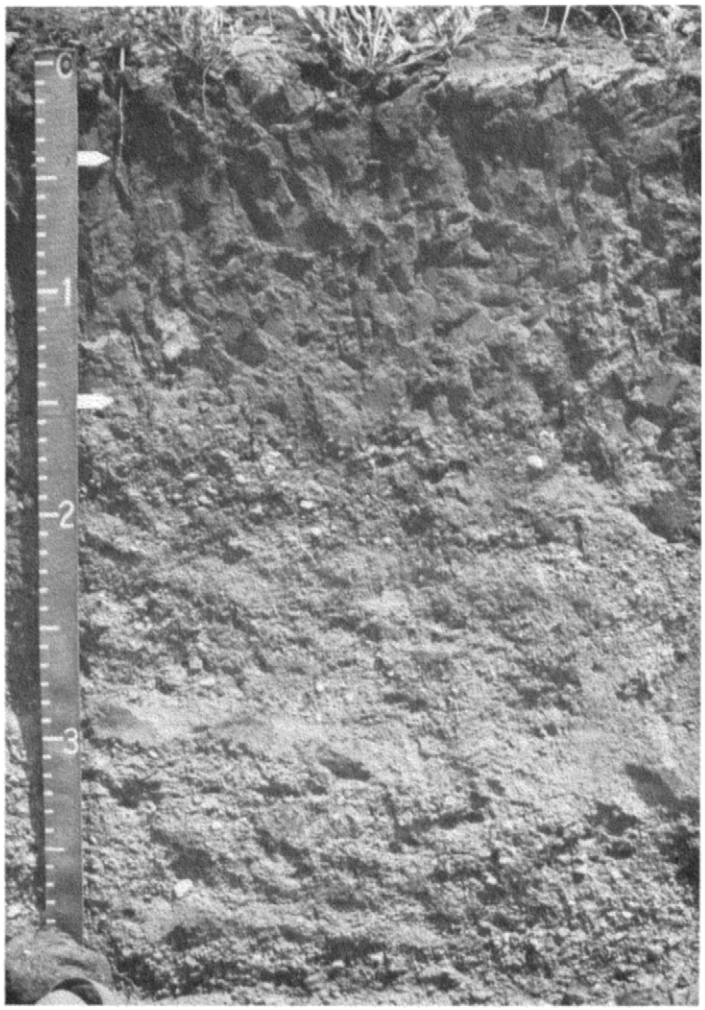

Figure 8.—**Profile of a Delmont soil in an area of Delmont-Talmo loams, 6 to 9 percent slopes.**

Delmont-Talmo loams, 2 to 6 percent slopes (DeB).—Delmont soils make up 45 to 55 percent of this complex, and Talmo soils, 30 to 40 percent. These soils are on terraces along the East Fork of the Vermillion River and on uplands south of Lake Madison and Brant Lake. Delmont soils, which are on the side slopes, have the profile described as representative for the Delmont series. Talmo soils are on the steeper and more convex upper slopes and have a profile similar to the one described as representative for their series.

Included in mapping were areas of Dempster and Henkin soils. Dempster soils are on some of the longer and more gentle slopes. Henkin soils are on the lower slopes.

Some areas of this complex are cultivated to corn or small grain. Others are used for hay and pasture. Many areas are irregularly shaped and small and are managed with the surrounding soils. This complex is droughty, and the Talmo soils are too shallow for cultivation. Conservation of moisture and control of erosion are management needs. (Delmont part is in capability unit IVs–1, windbreak group 10, pasture group D; Talmo part is in capability unit VIs–2, windbreak group 10, not placed in a pasture group)

Delmont-Talmo loams, 6 to 9 percent slopes (DeC).—Delmont soils make up 40 to 50 percent of this complex, and Talmo soils, 30 to 40 percent. These undulating soils are mainly south of Lake Madison and Brant Lake. Delmont soils are on the mid and lower slopes. Talmo soils are on the more convex upper slopes. The Delmont and Talmo soils have profiles similar to those described as representative for their respective series.

Included in mapping were Dempster and Henkin soils. Dempster soils are on the longer and more gentle slopes. Henkin soils are generally downslope from the Delmont soils. Inclusions make up 10 to 20 percent of a given area of this mapping unit.

Some areas of this complex are cultivated, and small grain is the main crop grown. Other areas are used for hay and pasture. These soils are droughty, and the Talmo soils are too shallow for cultivation. Conservation practices that conserve moisture, reduce soil loss, and improve fertility are management needs. (Delmont part is in capability unit IVe–3, windbreak group 10, pasture group D; Talmo part is in capability unit VIs–2, windbreak group 10, not placed in a pasture group)

Dempster Series

The Dempster series consists of well-drained, nearly level to sloping, silty soils that are moderately deep over sand and gravel. They are on stream terraces and glacial outwash uplands, mainly south of Lake Madison and Brant Lake.

In a representative profile, the surface layer is dark grayish-brown silt loam about 10 inches thick. The subsoil is brown silty clay loam about 19 inches thick. It is slightly hard when dry and friable when moist. The underlying material is calcareous, pale-brown loam underlain by sand and gravel below a depth of 36 inches.

Dempster soils have moderate organic-matter content and medium fertility. Surface runoff is slow to medium, and permeability is moderate above the underlying sand and gravel. Available water capacity is moderate. Water erosion is a hazard in sloping areas.

Most areas of these soils are used as cropland. Corn and small grain are the main crops grown, but all crops commonly grown in the county are suitable. This soil is well suited to irrigation.

Representative profile of Dempster silt loam, 0 to 2 percent slopes, in a cultivated field, 1,290 feet east and 725 feet north of the southwest corner of sec. 16, T. 105 N., R. 51 W.

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; cloddy; weak, fine, granular structure; soft when dry, friable when moist, slightly sticky when wet; slightly acid; abrupt, smooth boundary.

A12—6 to 10 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; weak, coarse, prismatic structure parting to weak, coarse, subangular blocky and weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky when wet; slightly acid; clear, wavy boundary.

B21—10 to 18 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) when moist, dark brown (10YR 4/3) when moist and crushed; weak, coarse and medium, prismatic structure parting to weak, coarse and medium, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; thin, patchy clay films on vertical ped faces; neutral; gradual, wavy boundary.

B22—18 to 29 inches, brown (10YR 5/3) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; weak, coarse and medium, prismatic structure parting to moderate, coarse and medium, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; thin, patchy clay films on vertical ped faces; neutral; clear, wavy boundary.

C1ca—29 to 36 inches, pale-brown (10YR 6/3) loam, dark grayish brown (2.5Y 4/2) when moist; weak, very coarse and coarse, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; many fine and medium lime segregations; calcareous; moderately alkaline; clear, smooth boundary.

IIC2—36 to 60 inches, brown (10YR 5/3) sand and gravel, dark brown (10YR 4/3) when moist; single grained; loose; calcareous; moderately thick lime crusts on undersides of gravel; moderately alkaline.

The A horizon ranges from 6 to 12 inches in thickness and from dark gray to dark grayish brown in color. The B horizon ranges from 14 to 28 inches in thickness and from dark gray to pale brown in color. The structure of the B horizon ranges from weak to moderate prismatic that parts to weak to moderate subangular blocky. Texture of the B horizon is silt loam or silty clay loam. Depth to lime ranges from 20 to 30 inches. The Cca horizon is loam or clay loam. In places this horizon is absent, and the B horizon is immediately above the IIC horizon. Depth to sand and gravel ranges from 20 to 40 inches.

Dempster soils are more shallow over sand and gravel and are better drained than Graceville soils. They are more silty than Delmont, Enet, and Henkin soils. They also are deeper over sand and gravel than Delmont soils. They have a coarser textured C horizon than Egan and Wentworth soils.

Dempster silt loam, 0 to 2 percent slopes (DmA).—This soil is on uplands and on stream terraces, mainly in the area south of Lake Madison and Brant Lake (fig. 9). The profile is the one described as representative for the series.

Included in mapping were areas of Graceville soils in slightly depressional areas and swales. This inclusion makes up less than 15 percent of any given area of this mapping unit.

Nearly all of this soil is cultivated. Corn, small grain, and alfalfa are the main crops grown. This is an ideal soil to irrigate. It is somewhat droughty during periods of low rainfall. Conservation of moisture and maintenance of fertility and organic-matter content are management needs. (Capability unit IIs–2, windbreak group 6, pasture group D)

Dempster silt loam, 2 to 6 percent slopes (DmB).—This gently sloping soil is on uplands and stream terraces, mainly south of Lake Madison and Brant Lake. Slopes are convex and fairly smooth. The surface layer has a few more pebbles and stones and is slightly thinner than that of the profile described as representative for the series. The depth to sand and gravel in most areas ranges from 30 to 36 inches but is as shallow as 20 inches in a few places.

Included in mapping were areas of Delmont, Graceville, Henkin, and Talmo soils. Delmont, Henkin, and Talmo soils are on the upper slopes, on ridgetops, and on side slopes along drainageways. Graceville soils are in swales. Inclusions make up less than 15 percent of any given area of this mapping unit.

Most areas of this soil are cultivated. Corn, small grain, and alfalfa are the main crops grown. This soil has good qualities for irrigating. Conservation of moisture and

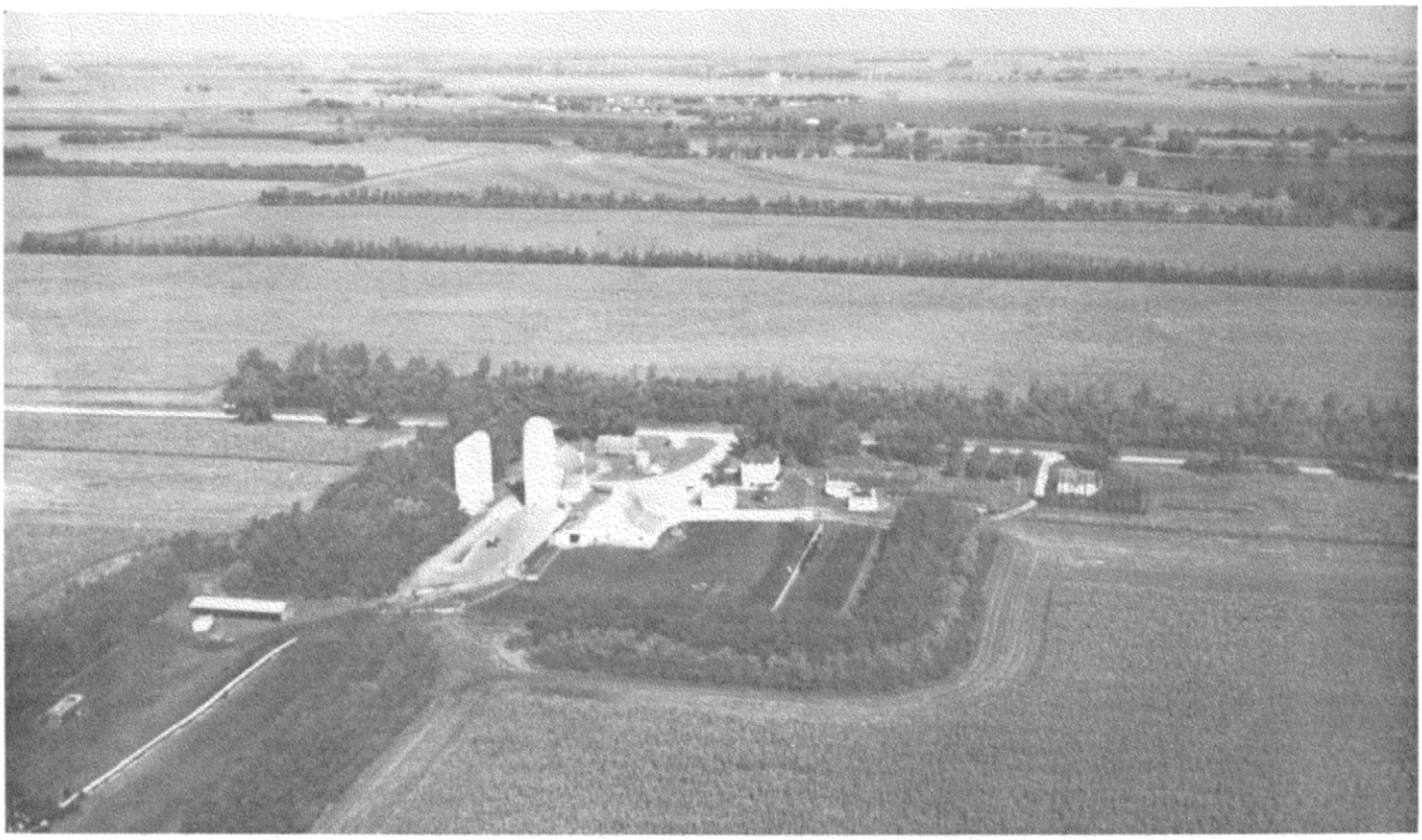

Figure 9.—**Area of Dempster silt loam, 0 to 2 percent slopes.**

control of erosion are management needs. (Capability unit IIIs–1, windbreak group 6, pasture group D)

Dempster-Delmont complex, 6 to 9 percent slopes (DpC).—Dempster soils make up 50 to 70 percent of this complex, and Delmont soils, 20 to 30 percent. Dempster soils are on the side slopes, and Delmont soils are on the convex upper slopes and ridgetops. The surface layer of the Dempster soils is thinner than that of the profile described as representative for the series, and it has a few pebbles and stones scattered over the surface. The subsoil ranges from 14 to 20 inches in thickness. The profile of the Delmont soils is similar to the one described as representative for the series.

Included in mapping were areas of Henkin and Talmo soils. Henkin soils are on slopes immediately below the Delmont soils. Talmo soils are on some of the ridgetops. Also included were places where the depth to lime is less than 20 inches and the depth to sand and gravel is as little as 20 inches. Inclusions make up less than 20 percent of any given area of this mapping unit.

Most areas of this complex are cultivated. Corn and small grain are the main crops grown. Control of erosion, conservation of moisture, and improvement of organic-matter content are management needs. (Capability unit IVe–3, windbreak group 6, pasture group D)

Egan Series

The Egan series consists of deep, well-drained, nearly level to sloping soils. These soils formed in silty material over glacial till. They are on uplands throughout much of the county.

In a representative profile (fig. 10), the surface layer is dark grayish-brown silty clay loam about 7 inches thick. The subsoil is brown, grayish-brown, and light brownish-gray silty clay loam about 24 inches thick. It is slightly hard and hard when dry and is friable when moist. The underlying material is calcareous, light brownish-gray clay loam glacial till.

Egan soils have moderate organic-matter content and medium to high fertility. Surface runoff is slow to medium, and permeability is moderate in the subsoil and moderately slow in the underlying material. Available water capacity is high.

Most areas of these soils are cultivated. Corn, flax, soybeans, and alfalfa are the main crops grown.

Representative profile of an Egan silty clay loam in an area of Egan-Wentworth silty clay loams, 2 to 6 percent slopes, in a cultivated field, 174 feet north and 1,440 feet east of the southwest corner of sec. 27, T. 107 N., R. 52 W.

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silty clay loam, black (10YR 2/1) when moist; weak, fine, granular structure; soft when dry, very friable when moist, slightly sticky when wet; slightly acid; abrupt, smooth boundary.

B21—7 to 15 inches, brown (10YR 5/3) silty clay loam, very dark grayish brown (10YR 3/2) when moist, dark brown (10YR 3/3) when moist and crushed; weak, medium, prismatic structure parting to weak, coarse and medium, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky

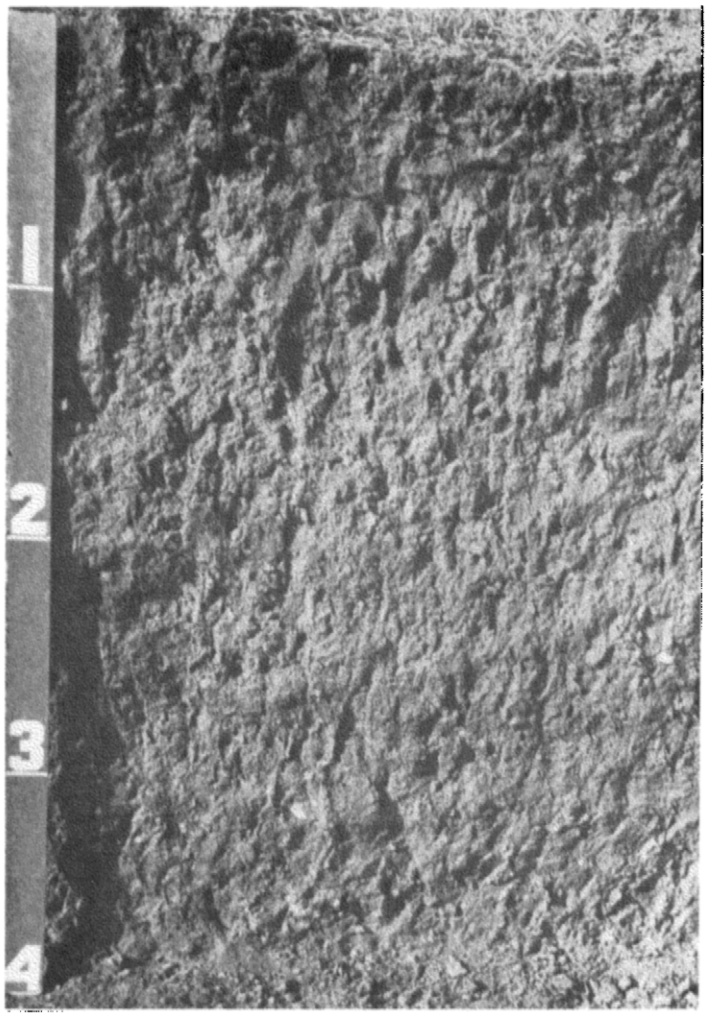

Figure 10.—**Profile of Egan silty clay loam from an area of Egan-Wentworth silty clay loams, 2 to 6 percent slopes.**

when wet; thin, patchy clay films on vertical ped faces; neutral; gradual, wavy boundary.

B22—15 to 24 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; weak to moderate, coarse, prismatic structure parting to weak, coarse, and medium, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; thin, patchy clay films on vertical ped faces; neutral; clear, wavy boundary.

B3ca—24 to 31 inches, light brownish-gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) when moist; common, fine, distinct mottles of strong brown (7.5YR 5/8); weak, coarse, blocky structure; hard when dry, friable when moist, slightly sticky when wet; common, fine, distinct iron concretions; many medium lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

IIC1—31 to 42 inches, light brownish-gray (2.5Y 6/2) clay loam, olive brown (2.5Y 4/4) when moist; moderate, coarse, prismatic structure parting to moderate, coarse, blocky structure; hard when dry, firm when moist, slightly sticky when wet; common, fine, distinct iron stains of strong brown (7.5YR 5/8); common, fine iron concretions; many fine lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

IIC2—42 to 60 inches, light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) when moist; moderate, coarse, blocky structure; hard when dry, firm when moist, slightly sticky when wet; many, fine, distinct iron stains of strong brown (7.5YR 5/8) and yellowish red (5YR 4/8) when moist; common fine and few medium iron concretions; few coarse and common fine lime segregations; calcareous; strongly alkaline; gradual, wavy boundary.

The A horizon ranges from 4 to 10 inches in thickness and from dark gray to dark grayish brown in color. The texture is mainly silty clay loam, but it is silt loam in places. The B horizon ranges from 16 to 30 inches in thickness. In places there is a mottled silty clay loam C horizon over the IIC horizon. Depth to lime ranges from 18 to 30 inches.

Egan soils have a less silty C horizon than Moody, Nora, and Wentworth soils. They have a thinner A horizon and are better drained than Viborg soils.

Egan silty clay loam, 6 to 9 percent slopes (EqC).—This soil is sloping to undulating and occurs on uplands. Areas of this soil are elongated and are parallel to the drainage pattern. The surface layer is 4 to 8 inches thick and has more pebbles and stones than that of the profile described as representative for the series. Depth to lime ranges from 18 to 24 inches.

Included in mapping were areas of Beadle, Viborg, and Wentworth soils. Beadle soils are on the crest of slopes, and Viborg soils are on footslopes and in swales. Wentworth soils occur in an erratic pattern. Inclusions make up less than 20 percent of a given area of this mapping unit.

Most of this soil is cultivated. Control of erosion and maintenance of organic-matter content are the main management needs. (Capability unit IIIe–1, windbreak group 3, pasture group F)

Egan-Beadle complex, 0 to 2 percent slopes (EbA).—Egan and Wentworth soils together make up about 60 percent of this complex, and Beadle soils, 30 percent. Areas of these soils are small in size, and the soils are closely intermingled. Egan soils are more extensive and have smoother, more nearly level slopes. Wentworth soils occur in an erratic pattern with the Egan soils in places where the silty material is thicker than 40 inches. Beadle soils are on small humps and slight rises. The surface layer of all three soils is generally dark gray and is slightly thicker than that of the profiles described as representative for their respective series. The Beadle soils have a surface layer that ranges from loam to silty clay loam in texture, and their subsoil is dark brown. Depth to lime in the Egan and Beadle soils is slightly more than in the profiles described as representative for those series.

Included in mapping were areas of Viborg soils in swales and slightly depressional areas. Inclusions make up less than 10 percent of any given area of this mapping unit.

Most areas of this complex are cultivated. These soils generally take in water easily and release it readily to plants. Management needs include the improvement of tilth and the maintenance of fertility and organic-matter content. (Egan part is in capability unit I–1, windbreak group 3, pasture group F; Beadle part is in capability unit IIs–1, windbreak group 4, pasture group E)

Egan-Beadle complex, 2 to 6 percent slopes (EbB).—Egan soils make up 50 to 70 percent of this complex, and Beadle soils, 20 to 40 percent. Wentworth soils are also in the complex with the Egan soils, and in some areas

they make up as much as 25 percent of the mapped area. Slopes are short and undulating (fig. 11) and are interlaced with many small drains. Egan and Wentworth soils are on the side slopes, and Beadle soils are on the shorter, convex slopes where firm clay loam glacial till is closer to the surface. The surface layer of the Egan soils contains more pebbles and grit than that of the profile described as representative for the series. The surface layer of the Beadle soils generally is silty clay loam, but it is loam and clay loam in places.

Included in mapping were areas of Ethan and Viborg soils. Ethan soils are on the crests of the slopes in places. Viborg soils are in swales. Inclusions make up about 10 percent of any given area of this mapping unit.

Most areas of this complex are cultivated. All crops common in the area are grown. Water is generally absorbed well and released readily to plants. Runoff is medium, and control of erosion is the main management need. Maintenance of organic-matter content, fertility, and tilth are other management needs. Mechanical practices are difficult to apply on many of the short, irregular slopes. (Egan part is in capability unit IIe–1, windbreak group 3, pasture group F; Beadle part is in capability unit IIIe–3, windbreak group 4, pasture group E)

Egan-Beadle complex, 6 to 9 percent slopes (EbC).—Egan soils make up 50 to 60 percent of this complex, and Beadle soils, 30 to 40 percent. These soils are in narrow areas on uplands and are mainly along drainageways. Slopes are short and convex. Beadle soils are on the more convex parts of slopes, and Egan soils are above and below the Beadle soils. The surface layer of these soils is slightly thinner than that of the profiles described as representative for their respective series. The surface layer of the Beadle soils is mainly silty clay loam, but in places it is loam. The subsoil of the Beadle soils is generally dark brown to grayish brown in color. Depth to lime is slightly less in both soils than in the profiles described as representative for their respective series.

Included in mapping were areas of Ethan, Viborg, and Wentworth soils. Ethan soils are on the crest of slopes. Viborg soils are in swales, and Wentworth soils are on foot slopes. Inclusions make up less than 20 percent of any given area of this mapping unit.

Most areas of this complex are cultivated. Crops common in the county are grown. Runoff is medium. Control of water erosion is the main management need, but maintenance of tilth and fertility are also management needs. (Egan part is in capability unit IIIe–1, windbreak group 3, pasture group F; Beadle part is in capability unit IIIe–5, windbreak group 4, pasture group E)

Egan-Ethan complex, 2 to 6 percent slopes (EeB).—Egan soils make up 40 percent of this complex; Ethan soils, 25 percent; and Beadle soils, 25 percent. The areas generally are small and irregularly shaped. Egan soils are on the smooth side slopes. Ethan and Beadle soils are on the more convex upper slopes. These soils have a profile similar to the one described as representative for their respective series, except that in eroded areas the Beadle and Ethan soils have a thinner surface that has been mixed with the subsoil by plowing.

Included in mapping were areas of Viborg soils in small swales. Inclusions make up less than 10 percent of any given area of this mapping unit.

Most areas of this complex are cultivated, but because of their small size they are managed with larger areas of adjacent soils. Runoff is medium, and control of water

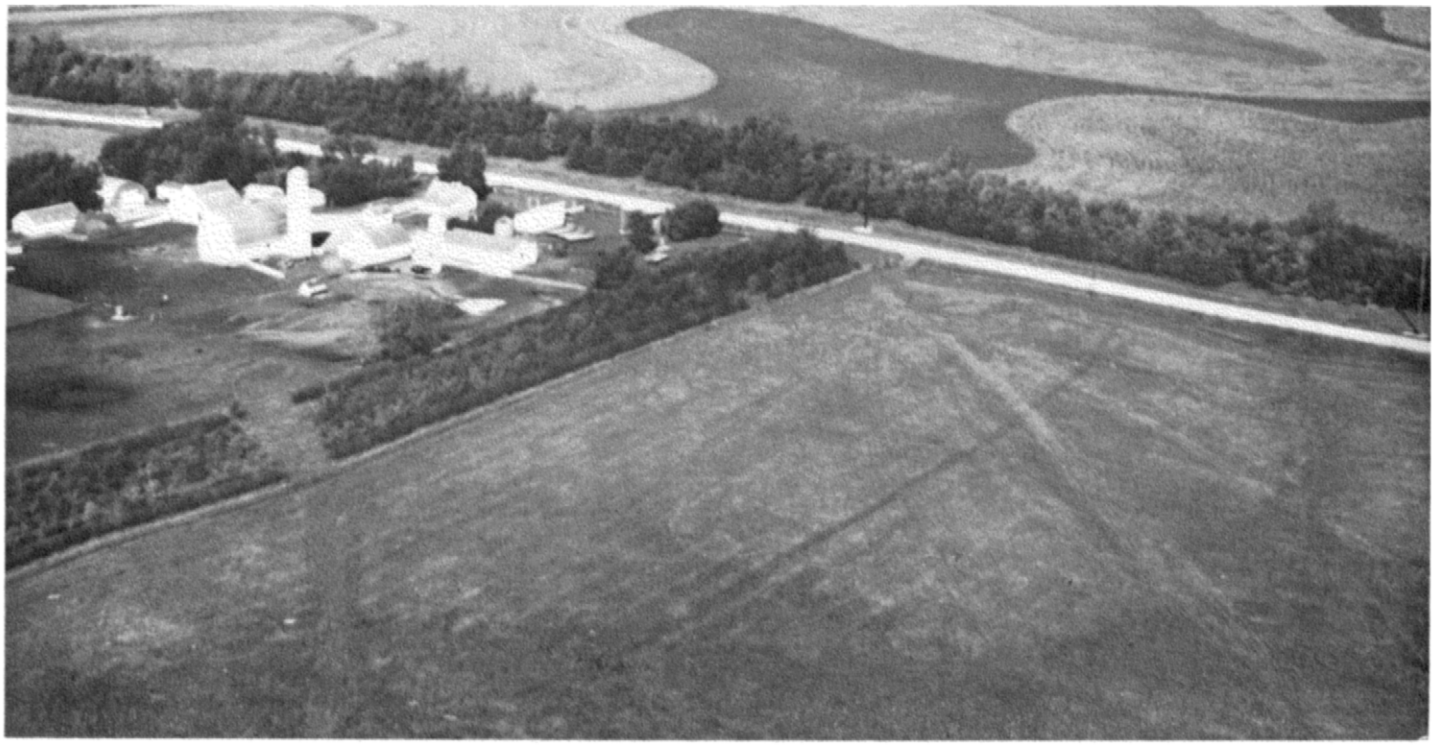

Figure 11.—**Area of Egan-Beadle complex, 2 to 6 percent slopes.**

erosion is the main management need. Practices that maintain fertility and organic-matter content are also needed. (Capability unit IIe–1, windbreak group 3, pasture group F)

Egan-Ethan complex, 6 to 9 percent slopes, eroded (EeC2).—Egan soils make up 40 percent of this complex, and Ethan and Beadle soils each make up 20 to 30 percent. These soils are in irregularly shaped areas that are long and narrow and are along drainageways and around depressions. They generally are less than 20 acres in size. Small crossable drains are common. Egan soils, on the mid and lower side slopes, have a profile similar to the one described as representative for the series, except that the surface layer is thinner. Ethan and Beadle soils are on the more convex and shorter upper slopes. Their surface layer is thinner than that of the profile described as representative for their respective series, and in many areas the Ethan soils are so eroded and mixed with the subsoil by plowing that they are easily distinguished by their light color. In some areas the Beadle soils are also eroded, and plowing has mixed the brown, clayey subsoil with the surface layer.

Included in mapping were areas of Viborg soils in small swales. Inclusions make up 10 to 20 percent of a given area of this mapping unit.

Most areas of this complex are cultivated. Corn, small grain, and alfalfa are suitable crops. Some areas are in tame pasture. Runoff is medium, and control of erosion is the main management need. Erosion has reduced the organic-matter content and fertility of these soils so much that improvement of those qualities is also an important management need. Mechanical conservation practices are difficult to apply because of the short, irregular slopes. The alternative is to use grasses and legumes in the cropping system for longer periods of time. (Capability unit IVe–4, windbreak group 3, pasture group F)

Egan-Viborg silty clay loams, 0 to 3 percent slopes (EgA).—Egan soils make up 30 to 50 percent of this complex; Viborg soils, 20 to 40 percent; and Wentworth soils, 10 to 30 percent. The irregularly shaped areas range from 25 to 200 acres in size and typically have many small swales. Egan soils are on the slight rises, and Viborg soils are in the swales. Wentworth soils are on the longer plane-shaped slopes between the Egan and Viborg soils. The profile of the Egan and Wentworth soils has a thicker surface layer and is somewhat deeper to lime than the profile described as representative for those series. The Viborg soils have a profile similar to the one described as representative for the series.

Included in mapping were areas of Beadle and Whitewood soils. Beadle soils are on sharply rising humps, and Whitewood soils are in some of the more deeply entrenched swales and in small depressions. Also included were small areas of a moderately well drained, calcareous soil that rims the edges of the swales or occupies small humps within the swales. Inclusions make up less than 10 percent of any given area of this mapping unit.

Most areas of this complex are cultivated. Runoff is slow and tends to accumulate on the Viborg part of the complex. In most years this additional moisture is more beneficial than harmful, but in years of high rainfall, tillage operations are delayed by the temporary wetness. Management needs include the maintenance of tilth, organic-matter content, and fertility. (Capability unit I–1, windbreak group 3, pasture group F)

Egan-Wentworth silty clay loams, 2 to 6 percent slopes (EhB).—Egan soils make up 50 to 60 percent of this complex, and Wentworth soils, 30 to 40 percent. Areas of these soils range from 5 to 300 acres in size. Slopes are mostly long and smooth, but some areas of Egan soils have shorter, more convex slopes. Wentworth soils are on the longer, smoother side slopes. The Egan and Wentworth soils have a profile similar to the one described as representative for their respective series, except for small eroded spots where the surface layer is thinner and has been mixed with the subsoil by plowing.

Included in mapping were areas of Beadle, Viborg, and Whitewood soils. Beadle soils are on the crest of some slopes where the silty drift thins out over the clay loam till. Viborg and Whitewood soils are in swales. Inclusions make up 10 to 20 percent of a given area of this mapping unit.

Most areas of this complex are cultivated. Corn, small grain, and alfalfa are the main crops, but flax, soybeans, sorghums, and tame grasses are also grown. These soils take in water easily and have good tilth. Control of water erosion is the main management need. Also needed are practices that maintain tilth, organic-matter content, and fertility. (Capability unit IIe–1, windbreak group 3, pasture group F)

Enet Series

The Enet series consists of well-drained, nearly level, loamy soils that are moderately deep over sand and gravel. These soils formed in glacial melt-water sediments and occupy stream terraces.

In a representative profile, the surface layer is dark-gray loam about 7 inches thick. The subsoil is dark grayish-brown loam about 16 inches thick. It is slightly hard when dry and friable when moist. The underlying material is glacial outwash that consists of brown, loose, stratified sand and gravel.

Surface runoff is slow, permeability is moderate to moderately rapid, and the available water capacity is low. Soil blowing is a hazard. Content of organic matter is moderate, and fertility is low to medium.

Most of the acreage of these soils is cultivated. Corn, small grain, and alfalfa are the main crops grown.

Representative profile of Enet loam, 0 to 2 percent slopes, in a cultivated field, 175 feet north and 1,584 feet east of the southwest corner of sec. 34, T. 106 N., R. 54 W.

Ap—0 to 7 inches, dark-gray (10YR 5/1) loam, black (10YR 2/1) when moist and very dark gray (10YR 3/1) when moist and crushed; weak, fine, granular structure; soft when dry, very friable when moist; neutral; abrupt, smooth boundary.

B21—7 to 17 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) when moist and very dark grayish brown (10YR 3/2) when moist and crushed; weak, coarse, prismatic structure parting to weak, coarse and medium, subangular blocky structure; slightly hard when dry, friable when moist; neutral; clear, wavy boundary.

B22—17 to 23 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure parting to weak, coarse, subangular blocky structure; soft when dry, friable when moist; neutral; abrupt, smooth boundary.

IICca—23 to 60 inches, brown (10YR 5/3) coarse sand and gravel, dark brown (10YR 4/3) when moist; single grained; loose; calcareous; lime crusts on gravel; moderately alkaline.

The A horizon ranges from 6 to 9 inches in thickness and from dark gray to very dark gray in color. The B horizon ranges from 12 to 27 inches in thickness and from dark grayish brown to dark brown in color. In places there is a thin, loamy C horizon between the B and IIC horizons. Depth to sand and gravel ranges from 20 to 36 inches. The weak to moderate accumulation of lime is generally in the upper part of the sand and gravel, and in areas where the depth to gravel is greater than 30 inches, the lower part of the B horizon is calcareous.

Enet soils are more loamy than Dempster soils. They are deeper over sand and gravel than Delmont and Talmo soils, and they are less sandy in the B horizon than Henkin soils.

Enet loam, 0 to 2 percent slopes (EnA).—This soil is on stream terraces, mainly along the East Fork of the Vermillion River and along Battle Creek. Slopes are plane to slightly convex.

Included in mapping are small areas of Delmont, Graceville, and Talmo soils. Delmont and Talmo soils are on slight rises and humps; Graceville soils are in swales. Inclusions make up less than 10 percent of any given area of this mapping unit.

Nearly all of this soil is cultivated. Corn, small grain, and alfalfa are the main crops. Most areas are suitable for irrigation. Water is available for plants only in the layers above the sand and gravel, and the soil is droughty. Management needs are conservation of moisture, control of soil blowing, and maintenance of fertility and organic-matter content. (Capability unit IIs–2, windbreak group 6, pasture group D)

Ethan Series

The Ethan series consists of deep, well-drained, gently undulating to steep, loamy soils that formed in calcareous glacial till on uplands (fig. 12). These soils are on the most convex parts of the landscape.

In a representative profile, the surface layer is calcareous, dark grayish-brown loam about 7 inches thick. The subsoil is dark grayish-brown clay loam about 5 inches thick. It is slightly hard when dry and friable when moist. In it are spots and masses of lime that extend into the underlying material. The underlying material is calcareous, light brownish-gray clay loam glacial till.

Ethan soils have moderately low organic-matter content and low fertility. Surface runoff is medium to rapid, and permeability is moderate to moderately slow. Available water capacity is high. Water erosion is a hazard.

The steeper areas of these soils are in grass and are used as pasture. Less sloping areas are cultivated. Corn, small grain, and alfalfa are the main crops.

Representative profile of an Ethan loam from an area of Clarno-Ethan loams, 9 to 16 percent slopes, in a bluegrass pasture, 435 feet north and 2,250 feet east of the southwest corner of sec. 3, T. 106 N., R. 54 W.

A1—0 to 7 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) when moist, very dark grayish brown (10YR 3/2) when moist and crushed; weak, fine, granular structure; soft when dry, very friable when moist; calcareous; neutral; clear, wavy boundary.

B2—7 to 12 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; tongues of very dark brown (10YR 2/2) when moist; weak, coarse, prismatic structure parting to weak, fine and medium, granular structure; slightly hard when dry, friable when moist, sticky when wet; common, fine, distinct lime segregations; calcareous; mildly alkaline; gradual, wavy boundary.

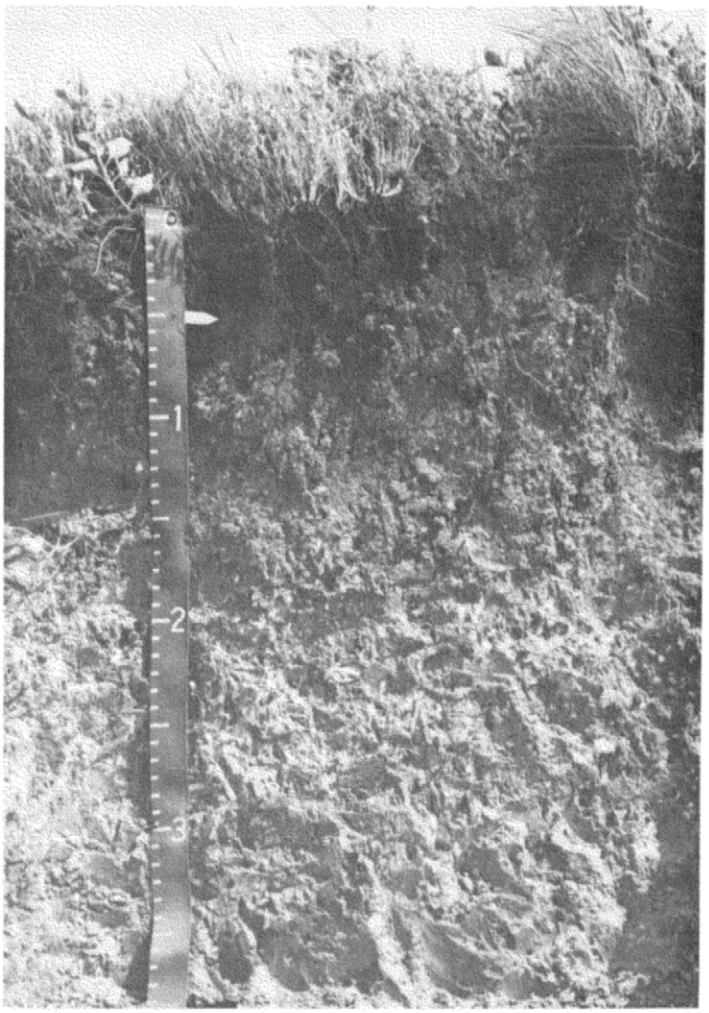

Figure 12.—**Profile of an Ethan loam in an area of Clarno-Ethan loams, 9 to 16 percent slopes.**

C1ca—12 to 28 inches, light brownish-gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) when moist; common, fine and medium, distinct mottles of black (N 2/0) and yellowish brown (10YR 5/8) when moist; weak, coarse, blocky structure; hard when dry, firm when moist, sticky when wet; few, coarse, prominent and common, fine, distinct iron concretions; many, fine and medium, distinct lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C2—28 to 40 inches, light brownish-gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) when moist; common, fine and medium, distinct mottles of black (N 2/0) and many, fine, distinct mottles of yellowish brown (10YR 5/8) and brownish yellow (10YR 6/8) and many, fine, prominent mottles of red (2.5YR 5/8) when moist; moderate, coarse and medium, blocky structure; hard when dry, firm when moist, sticky when wet; common, fine and medium, distinct iron concretions; common, fine and medium, distinct lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C3—40 to 60 inches, light brownish-gray (2.5Y 6/2) clay loam, olive brown (2.5Y 4/4) when moist; many, fine and medium, distinct mottles of black (N 2/0) and olive yellow (2.5Y 6/8) when moist; massive; hard when dry, firm when moist, sticky when wet; many, fine and medium, distinct iron concretions; few, medium, distinct and common, fine, distinct lime segregations; calcareous; strongly alkaline.

The A horizon ranges from 5 to 7 inches in thickness, from dark gray to dark grayish brown in color, and from neutral to moderately alkaline in reaction. Pebbles and stones on the surface and in the profile vary in size and in amount. The A horizon in cultivated areas has been partly removed or mixed with the B horizon. The B horizon ranges from grayish brown to dark grayish brown in color and from loam to clay loam in texture. Lime concretions range from few to many in the lower part of the B horizon and in the upper part of the C horizon. The C horizon is glacial till that ranges from friable loam to firm clay loam. In places there are pockets of gravel and gypsum in the lower part of the C horizon.

Ethan soils are less silty than Egan and Wentworth soils. They have a thinner B horizon and are calcareous at a shallower depth than Clarno soils. Ethan soils have a thicker A horizon than Betts soils.

Ethan-Betts loams, 21 to 40 percent slopes (EoF).—Ethan soils make up 25 to 45 percent of this complex, and Betts soils, 25 to 40 percent. The steep soils in this complex are mainly along the East Fork of the Vermillion River. Areas of these soils are long and narrow along drainageways that dissect back into the uplands. Betts soils are on the steepest parts of the complex on short slopes that include cut-banks, slips, and slides. Ethan soils are above and below these slopes. They have a profile similar to the one described as representative for the series, except that the surface layer and subsoil are thinner. The profile of the Betts soils is the one described as representative for the series.

Included in mapping were areas of Clarno, Davis, Lamo, and Talmo soils. Clarno soils are in less sloping areas midway down the slopes. Davis soils are on foot slopes and fans. Lamo soils are on the bottoms of the drainageways. Talmo soils are on rounded, gravelly knobs. Inclusions make up 15 to 40 percent of a given area of this mapping unit.

This complex is used only as pasture. Use of haying machinery is not practical, because of the steep slopes. Surface runoff is rapid. If in poor vegetative condition, steeper parts of the complex start to slough and erosion is accelerated. Control of erosion is the main management need. (Capability unit VIe–1, windbreak group 10, not placed in a pasture group)

Ethan-Clarno loams, 16 to 21 percent slopes (ErE).—Ethan soils make up 55 to 65 percent of this complex, and Clarno soils, 20 to 30 percent. These hilly soils are on uplands. Ethan soils, which are on the upper slopes, have a profile similar to the one described as representative for the series, except that the surface layer and subsoil are thinner. Clarno soils are on the lower parts of the slopes. They have a profile similar to that described as representative for the series, except that the surface layer and subsoil are slightly thinner.

Included in mapping were areas of Davis and Lamo soils. Davis soils are on foot slopes and fans. Lamo soils are on the bottoms of the drainageways. Inclusions make up 5 to 25 percent of a given area of this mapping unit.

The soils in this complex have slopes that are too steep for cultivation and are used mostly for pasture and hay. Runoff is rapid, and unprotected surfaces erode easily. Control of water erosion is the main management need. (Capability unit VIe–1, windbreak group 10, pasture group F)

Ethan-Clarno stony complex, 6 to 25 percent slopes (EsE).—Ethan soils make up 40 to 50 percent of this complex; Clarno soils, 25 to 35 percent; and Davis soils, 15 to 25 percent. These undulating to hilly soils are on uplands, mainly along the East Fork of the Vermillion River. Areas of these soils generally are long and narrow and are along drainageways. Stones and cobblestones are commonly on peaks of hills and ridges in areas up to 4 acres in size (fig. 13), but in places they cover the entire slope. Ethan soils are steeper and have the more convex slopes of the complex. Clarno soils are less steep and are on the less stony side slopes. Davis soils are in swales and on foot slopes.

Ethan soils have a profile that is more stony than that described as representative for the series and have a subsoil that is very weakly developed. Clarno soils have a slightly thinner surface layer and subsoil than those of the profile described as representative for the series and in places are stony on the surface. The Davis soils have a profile similar to the one described as representative for the series, except that the surface layer and subsoil are slightly thinner.

Included in mapping were small areas of Tetonka and Whitewood soils. Tetonka soils are in small depressions, and Whitewood soils are in swales. Inclusions make up less than 10 percent of any given area of this mapping unit.

Many areas of this complex are in native grass and are used for grazing. The soils of this complex are well suited to pasture, and some areas of stone-free Clarno and Davis soils are large enough to be used for crops or as hayland. Stoniness and steepness of slopes make the Ethan soils in this complex unsuitable for cultivation and hinder haying operations. Maintenance of a good vegetative cover is necessary for the control of erosion.

Figure 13.—**An area of Ethan-Clarno stony complex, 6 to 25 percent slopes.**

(Ethan part is in capability unit VIIs–1, windbreak group 10, not placed in pasture group; Clarno part is in capability unit IVe–2, windbreak group 3, pasture group F)

Ethan-Davis stony complex, 3 to 21 percent slopes (EtD).—Ethan soils make up 50 to 60 percent of this complex, and Davis soils, 20 to 30 percent. These undulating to hilly soils are on glacial moraines that are interlaced with drains, swales, and depressions and are mainly along the East Fork of the Vermillion River. Ethan soils have the steeper and more convex slopes of the complex. Their presence is marked by numerous stones and cobblestones on the surface. The stones are 2 to 5 feet apart and are commonly in areas that are less than one-half acre in size. In addition to having a profile that is more stony than the one described as representative for the series, Ethan soils have underlying material that commonly consists of stratified sandy, loamy, and gravelly materials over loamy glacial till. Davis soils have the lower, more gentle slopes and are in swales. They have a profile similar to the one described as representative for the Davis series.

Included in mapping were areas of Clarno and Tetonka soils. Clarno soils are on side slopes between the Ethan and Davis soils. Tetonka soils are in depressions. Inclusions make up 10 to 20 percent of a given area of this mapping unit.

Many areas of this complex are in native grass and are used for grazing. Stoniness and steepness of slopes limit the use of the Ethan parts of the complex as hayland, but haying is practical on the Clarno and Davis soils. Most of the Davis soils have slopes of less than 6 percent and are suitable for cultivation. Control of erosion is a management need in areas that have a poor vegetative cover. (Ethan part is in capability unit VIIs–1, windbreak group 10, not placed in pasture group; Davis part is in capability unit IIe–2, windbreak group 1, pasture group K)

Graceville Series

The Graceville series consists of deep, moderately well drained, nearly level soils that formed in a thick mantle of silty material over sand and gravel. These soils are in swales or slightly depressional areas on uplands and on stream terraces.

In a representative profile, the surface layer is dark grayish-brown silty clay loam about 20 inches thick. The subsoil is silty clay loam to a depth of about 53 inches. It is dark grayish brown in the upper part, brown in the middle part, and light yellowish brown mottled with reddish brown in the lower part. It is slightly hard when dry and friable when moist. The underlying material is dark-brown sand and gravel.

Graceville soils have high organic-matter content and fertility. Surface runoff is slow, and permeability is moderate. Areas of these soils occasionally receive runoff water from adjacent soils. The available water capacity is moderate to high.

Most areas of these soils are farmed. Corn, oats, soybeans, and alfalfa are the main crops.

Representative profile of Graceville silty clay loam, in a cultivated field, 330 feet north and 2,301 feet west of the southeast corner of sec. 9, T. 105 N., R. 51 W.

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silty clay loam, black (10YR 2/1) when moist; weak, fine, granular structure; soft when dry, very friable when moist, slightly sticky when wet; medium acid; abrupt, smooth boundary.

A12—8 to 20 inches, dark grayish-brown (10YR 4/2) silty clay loam, black (10YR 2/1) when moist, very dark brown (10YR 2/2) when moist and crushed; weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky when wet; medium acid; gradual, wavy boundary.

B1—20 to 27 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark gray (10YR 3/1) when moist, very dark grayish brown (10YR 3/2) when moist and crushed; weak, coarse, prismatic structure parting to weak, coarse and medium, subangular blocky structure parting in turn to weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky when wet; slightly acid; clear, wavy boundary.

B21—27 to 39 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) when moist; weak, coarse and medium, prismatic structure parting to moderate, coarse, medium, and fine, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; slightly acid; gradual, wavy boundary.

B22—39 to 53 inches, light yellowish-brown (10YR 6/4) silty clay loam, dark brown (10YR 4/3) when moist; few, fine, distinct mottles of reddish brown (2.5YR 4/4) when moist; moderate, coarse and medium, prismatic structure parting to moderate, coarse, medium, and fine, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; slightly acid; abrupt, smooth boundary.

IIC—53 to 60 inches, dark-brown (10YR 4/3) sand and gravel, dark brown (10YR 3/3) when moist; single grained; loose; slightly acid.

The A horizon ranges from 12 to 22 inches in thickness and from dark gray to dark grayish brown in color. Texture is mainly silty clay loam, but there are areas of silt loam in places. The B horizon ranges from 26 to 40 inches in thickness. The depth to stratified mixed sand and gravel is 40 inches or more. In places there is a silty C horizon between the B and IIC horizons. Color of the IIC horizon ranges from dark brown to yellowish brown. Depth to lime ranges from 36 to 60 inches or more.

Graceville soils have a coarser textured C horizon than Viborg soils, which are in similar positions on the landscape. They are less well drained, are deeper over sand and gravel, and have a thicker A horizon than Dempster and Enet soils.

Graceville silty clay loam (0 to 2 percent slopes) (Gr).—This nearly level soil is in slightly depressional areas and in swales on uplands and stream terraces south of Lake Madison and Brant Lake.

Included in mapping were small areas of Dempster soils, which are on the side slopes of swales. Inclusions make up less than 10 percent of any given area.

Most of this soil is cultivated. Row crops, small grain, and other crops common in the county are suitable. Practices that maintain fertility and tilth are the management needs. (Capability unit I–1, windbreak group 1, pasture group K)

Henkin Series

The Henkin series consists of deep, well-drained, nearly level to sloping, loamy soils on uplands south of Lake Madison and Brant Lake. These soils formed in loamy to sandy glacial melt-water deposits.

In a representative profile, the surface layer is dark grayish-brown loam about 5 inches thick. The subsoil is

sandy loam about 24 inches thick; it is grayish brown in the upper part, brown in the middle part, and pale brown in the lower part. It is soft when dry and very friable when moist. The lower part is calcareous. The underlying material is calcareous, light yellowish-brown and pale-yellow, stratified loamy and sandy material.

Henkin soils are moderately low in organic-matter content and low to medium in fertility. Surface runoff is slow to medium, and permeability is moderately rapid. Available water capacity is low to moderate, and the soils are droughty.

Many areas of these soils are cultivated. All crops common in the county are suitable. Some areas are used for hay and pasture.

Representative profile of Henkin loam, 3 to 9 percent slopes, in a pasture 675 feet south and 1,210 feet west of the northeast corner of sec. 19, T. 105 N., R. 51 W.

Ap—0 to 5 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky when wet; slightly acid; abrupt, smooth boundary.

B21—5 to 11 inches, grayish-brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse and medium, prismatic structure parting to weak, very coarse and coarse, subangular blocky structure; slightly hard when dry, very friable when moist, slightly sticky when wet; slightly acid; gradual, wavy boundary.

B22—11 to 21 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) when moist; weak, coarse, prismatic structure parting to weak, very coarse and coarse, subangular blocky structure; soft when dry, very friable when moist, slightly sticky when wet; neutral; clear, wavy boundary.

B3ca—21 to 29 inches, pale-brown (10YR 6/3) sandy loam, dark brown (10YR 4/3) when moist; weak, very coarse and coarse, subangular blocky structure; soft when dry, very friable when moist; common fine lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C1ca—29 to 48 inches, light yellowish-brown (2.5Y 6/3) sandy loam, light olive brown (2.5Y 5/3) when moist; massive; soft when dry, very friable when moist, slightly sticky when wet; few, fine, distinct iron stains that are strong brown (7.5YR 5/8) when moist; common fine lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C2—48 to 60 inches, pale-yellow (2.5Y 7/3) stratified loamy sand, loam, and clay loam, light olive brown (2.5Y 5/3) when moist; massive; slightly hard when dry, friable when moist, slightly sticky when wet; few, fine, distinct iron stains that are strong brown (7.5YR 5/8) when moist; few, fine, distinct iron concretions; calcareous; moderately alkaline.

The A horizon ranges from 4 to 10 inches in thickness, from dark gray to dark grayish brown in color, and from loam to sandy loam in texture. The B horizon ranges from 22 to 40 inches in thickness. In places the upper part is loam. Depth to lime ranges from 18 to 36 inches. The stratified C horizon ranges in texture from sand to clay loam and in color from light brownish gray to very pale brown and pale yellow.

Henkin soils have more sand in the B horizon than the Delmont, Dempster, and Enet soils, and they lack sand and gravel at a depth of less than 40 inches.

Henkin loam, 0 to 3 percent slopes (HeA).—This soil is on uplands and terraces along large lakes, sloughs, and creeks. The surface layer is thicker than that of the profile described as representative for the series, and lime is at a greater depth.

Included in mapping are small areas of Enet soils. They occur in an erratic pattern in places where gravel is in the stratified underlying material and where the sandy layers are thicker than those in the profile described as representative for the Henkin series.

Most areas of this soil are cultivated. Corn and small grain are the main crops. This soil is somewhat droughty and is susceptible to soil blowing. Conservation of moisture and control of soil blowing are the main management needs, although the maintenance of fertility and organic-matter content is also important. (Capability unit IIIs–2, windbreak group 5, pasture group H)

Henkin loam, 3 to 9 percent slopes (HeB).—This gently sloping to sloping soil is on uplands and terraces. It has the profile described as representative for the series.

Included in mapping are areas of soils that have a surface layer of sandy loam. Also included are small areas of Delmont, Egan, and Talmo soils. The Delmont and Talmo soils are on convex upper slopes; Egan soils are on some of the side slopes. Inclusions make up less than 10 percent of any given area of this mapping unit.

Most areas of this soil are cultivated. This soil is suited to small grain, but all crops common in the county are grown. It is easy to work, but it is susceptible to erosion and is droughty. Control of erosion, conservation of moisture, and maintenance of organic-matter content and fertility are needed. (Capability unit IIIe–4, windbreak group 5, pasture group H)

Houdek Series

The Houdek series consists of deep, well-drained, nearly level to gently undulating, loamy soils on uplands. These soils are west of the East Fork of the Vermillion River. They formed in friable glacial till.

In a representative profile, the surface layer is dark-gray loam about 5 inches thick. The subsoil is clay loam about 24 inches thick. It is dark gray and dark grayish brown in the upper part and pale brown in the lower part. It is hard when dry and friable to firm when moist. The underlying material is calcareous, clay loam glacial till. It is very pale brown and contains gray mottles and yellowish-brown stains.

Houdek soils have moderate organic-matter content and medium fertility. Surface runoff is slow to medium, and permeability is moderate. The available water capacity is high.

Many areas of these soils are cultivated. Corn, small grain, and alfalfa are the main crops grown. Small areas are in native grass and are used for grazing and hay production. Native grasses include big bluestem, little bluestem, needle-and-thread, and western wheatgrass.

Representative profile of a Houdek loam in an area of Houdek-Prosper loams, 0 to 3 percent slopes, in a cultivated field, 330 feet west and 1,200 feet north of the southeast corner of sec. 7, T. 105 N., R. 54 W.

A1—0 to 5 inches, dark-gray (10YR 4/1) loam, black (10YR 2/1) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; neutral; gradual, wavy boundary.

B21t—5 to 10 inches, dark-gray (10YR 4/1) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, prismatic structure parting to moderate, coarse and medium, subangular blocky structure; hard when dry, friable when moist, slightly sticky when wet; thin, continuous clay films on vertical ped faces and thin, patchy clay films on

horizontal ped faces; neutral; gradual, wavy boundary.

B22t—10 to 16 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, prismatic structure parting to moderate, coarse and medium, subangular blocky structure; hard when dry, firm when moist, sticky when wet; thin, continuous clay films on vertical ped faces and thin, patchy clay films on horizontal ped faces; neutral; clear, wavy boundary.

B3ca—16 to 29 inches, pale-brown (10YR 6/3) clay loam, grayish brown (2.5Y 5/2) when moist; weak, very coarse, prismatic structure parting to weak and moderate, very coarse and coarse, subangular blocky structure; hard when dry, firm when moist, sticky when wet; thin, patchy clay films on vertical ped faces; common, fine, distinct lime segregations; calcareous; moderately alkaline; clear, wavy boundary.

C1ca—29 to 39 inches, very pale brown (10YR 7/3) clay loam, light olive brown (2.5Y 5/4) when moist; common, fine, faint mottles of gray (5Y 5/1) when moist; weak, thick, platy structure; hard when dry, firm when moist, sticky when wet; common, fine, distinct iron stains that are yellowish brown (10YR 5/6) when moist; common, fine, distinct lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C2—39 to 52 inches, very pale brown (10YR 7/3) clay loam, grayish brown (2.5Y 5/2) when moist; common, fine and medium, distinct mottles of gray (5Y 5/1) when moist; massive; hard when dry, firm when moist, sticky when wet; common, fine and medium, distinct iron stains that are yellowish brown (10YR 5/8) when moist; few, fine, distinct iron concretions; few, fine, distinct lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C3—52 to 60 inches, very pale brown (10YR 7/3) clay loam, grayish brown (2.5Y 5/2) when moist; common, fine and medium, distinct mottles of gray (5Y 5/1 and 5Y 6/1) when moist; massive; hard when dry, firm when moist, sticky when wet; iron stains that are yellowish brown (10YR 5/6) and brownish yellow (10YR 6/6) when moist; common, fine, distinct iron concretions; few, fine, distinct lime concretions; calcareous; moderately alkaline.

The A horizon ranges from 5 to 8 inches in thickness and from dark gray to dark grayish brown in color. The B horizon ranges from 8 to 24 inches in thickness. The upper part ranges from dark gray to dark grayish brown in color. Depth to lime ranges from 14 to 24 inches. In places the C horizon is loam. Reaction ranges from neutral to mildly alkaline in the A and B2 horizons and from moderately alkaline to strongly alkaline in the B3 and C horizons.

Houdek soils have a thinner A horizon and are better drained than the nearby Prosper soils. Their B horizon is less clayey than that of Beadle soils. Houdek soils have a greater increase in clay content between the A and B horizons than Clarno soils.

Houdek loam, 2 to 6 percent slopes (HkB).—This gently undulating soil is on uplands in the southwestern part of the county. Areas of this soil generally are small, but some range up to 150 acres in size. The profile is similar to the one described as representative for the series, except that in places the depth to lime is less. In eroded areas plowing has mixed the original surface layer with the upper part of the subsoil.

Included in mapping were areas of Clarno, Ethan, and Prosper soils. Clarno and Ethan soils are on short, convex slopes; they make up 35 percent of some of the larger areas of this mapping unit. Prosper soils are on footslopes and in swales. They make up less than 12 percent of any given area of this mapping unit.

Most areas of this soil are farmed, but some are used for grazing. Row crops and small grain are the main crops. Water erosion is the major limitation. Management is needed to reduce soil loss and maintain fertility. Mechanical conservation practices are needed on the longer slopes to control erosion. (Capability unit IIe–2, windbreak group 3, pasture group F)

Houdek-Prosper loams, 0 to 3 percent slopes (HpA).—Houdek soils make up 45 to 55 percent of this complex, and Prosper soils, 30 to 40 percent. Areas of this complex consist of many slight rises and swales and a few small depressions (fig. 14) and are in the southwestern corner of the county. Houdek soils, which are on slight rises, have the profile described as representative for the series. Prosper soils are on flats and in slight depressions and swales. They have a profile similar to the one described as representative for the series, except that in a few places the depth to lime is as shallow as 15 inches.

Included in mapping were areas of Beadle, Stickney, and Tetonka soils. Beadle soils are on the slight rises with Houdek soils. Stickney soils are in some of the swales. Tetonka soils are in flat-bottomed depressions. Also included were areas of a calcareous soil that occur as narrow rims around the Tetonka soils. Inclusions make up less than 15 percent of any given area of this mapping unit.

Most areas of this complex are farmed to row crops, small grain, alfalfa, and tame grasses. These soils readily take in water and are easy to work. Management needs include maintenance of tilth, organic-matter content, and fertility. (Capability unit I–1, windbreak group 3, pasture group F)

Lamo Series

The Lamo series consists of deep, somewhat poorly drained, nearly level, silty soils on bottom lands. These soils formed in alluvium deposited along streams in all parts of the county.

In a representative profile, the surface layer is calcareous, dark-gray and gray silty clay loam about 17 inches thick. Below the surface layer is a transition layer about 19 inches thick. It is calcareous, dark-gray silty clay loam that is slightly hard when dry and friable when moist. The underlying material is calcareous, gray silty clay loam that is stratified with sandy loam below a

Figure 14.—Area of Houdek-Prosper loams, 0 to 3 percent slopes.

depth of 52 inches. In it are spots and streaks of dark yellowish brown.

Lamo soils have high organic-matter content and fertility. Surface runoff is slow, and permeability is moderately slow. A water table is at a depth of about 2 feet during spring and recedes to a depth of 4 to 8 feet during summer and fall. Lamo soils are also subject to flooding and are slow to dry out in spring. Available water capacity is high.

Lamo soils are used for crops and pasture. Corn, soybeans, and alfalfa are well suited. Other crops can be grown, but usually the soil does not dry out early enough in spring for the preparation of a good seedbed. Some areas are used for pasture and as hayland.

Representative profile of Lamo silty clay loam, in a pasture, 138 feet north and 963 feet east of the southwest corner of sec. 4, T. 107 N., R. 52 W.

Ap—0 to 9 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) when moist; weak, coarse, to thin, platy structure parting to weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky when wet; calcareous; moderately alkaline; gradual, wavy boundary.

A12—9 to 17 inches, gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) when moist; weak, very coarse and coarse, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; calcareous; moderately alkaline; gradual, wavy boundary.

AC—17 to 36 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) when moist; common, fine, faint mottles of very dark grayish brown (10YR 3/2) when moist; weak, very coarse and coarse, subangular blocky structure parting to weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky when wet; calcareous; moderately alkaline; gradual, wavy boundary.

C1g—36 to 44 inches, gray (5Y 5/1) silty clay loam, dark gray (10YR 4/1) when moist; common, fine, distinct mottles of dark yellowish brown (10YR 4/4) when moist; massive; hard when dry, friable when moist, slightly sticky when wet; calcareous; moderately alkaline; gradual, wavy boundary.

C2g—44 to 52 inches, gray (5Y 5/1) silty clay loam, dark gray (5Y 4/1) when moist; distinct mottles of dark yellowish brown (10YR 4/4) when moist; massive; hard when dry, friable when moist, slightly sticky when wet; common, fine and medium, distinct lime segregations as nests and strips; calcareous; moderately alkaline; gradual, wavy boundary.

C3g—52 to 60 inches, gray (5Y 5/1) stratified silty clay loam and sandy loam, dark gray (5Y 4/1) when moist; many, fine, distinct mottles of dark yellowish brown (10YR 4/4) when moist; massive; hard when dry, friable when moist, slightly sticky when wet; calcareous; moderately alkaline.

The A horizon ranges from 12 to 20 inches in thickness and from silt loam to silty clay loam in texture. It is calcareous in most places. The AC horizon is silt loam or silty clay loam and in places is stratified with thin lenses of sand. Soft carbonate segregations are common in the AC horizon. The C horizon is commonly stratified with material that ranges from sand to clay in texture.

Lamo soils are better drained and less clayey than Rauville soils. They differ from Volga soils in that they do not contain sand and gravel in the profile at a depth of less than 40 inches. Lamo soils are not so well drained as Davis soils and are calcareous at or near the surface.

Lamo silty clay loam (0 to 2 percent slopes) (la).—This nearly level soil is on flood plains along streams in all parts of the county. Areas of this soil are long and narrow, and they range in size from 10 to 300 acres.

Included in mapping were areas of Davis, Rauville, and Volga soils. Davis soils are on narrow terraces above the Lamo soils. Rauville soils are in low areas. Volga soils are along channels in positions slightly above the Lamo soils. Inclusions are less than 3 acres in size and make up less than 15 percent of any given area of this mapping unit.

Many areas of this soil are cultivated. Some are used as hayland and some for pasture. Corn, soybeans, and alfalfa are the main crops grown. Planting is often delayed in spring because of wetness from flooding and from the rise of the water table. Providing adequate drainage is the main management need. This soil generally is low in phosphorus. (Capability unit IIw–2, windbreak group 2, pasture group A, drained, and B, undrained)

Moody Series

The Moody series consists of deep, well-drained, nearly level to gently sloping, silty soils on uplands in the southeastern corner of the county. These soils formed in loess.

In a representative profile, the surface layer is dark-gray silty clay loam about 10 inches thick. The subsoil, about 28 inches thick, is brown silty clay loam in the upper part and pale-brown silt loam in the lower part. It is slightly hard when dry and friable when moist. The underlying material is calcareous, pale-brown silt loam.

Moody soils have moderate organic-matter content and high fertility. Surface runoff is slow to medium, and permeability is moderate. Available water capacity is high.

Most areas of these soils are cultivated. Corn is the main crop, but small grain, soybeans, and alfalfa are also grown.

Representative profile of a Moody silty clay loam in an area of Moody-Nora complex, 2 to 6 percent slopes, in a cultivated field, 2,244 feet north and 390 feet east of the southwest corner of sec. 36, T. 105 N., R. 51 W.

Ap—0 to 5 inches, dark-gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky when wet; slightly acid; abrupt, smooth boundary.

A12—5 to 10 inches, dark-gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky when wet; neutral; clear, wavy boundary.

B21—10 to 18 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) when moist, dark brown (10YR 4/3) when moist and crushed; weak, medium, prismatic structure parting to moderate, coarse, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; thin, continuous clay films on ped faces; common fine pores; neutral; gradual, wavy boundary.

B22—18 to 27 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) when moist, dark brown (10YR 4/3) when moist and crushed; weak, coarse, prismatic structure parting to weak, coarse, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; thin, patchy clay films on ped faces; common fine pores; neutral; gradual, wavy boundary.

B3—27 to 38 inches, pale-brown (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) when moist; weak, coarse and very coarse, subangular blocky structure; slightly hard when dry, very friable when moist.

slightly sticky when wet; thin, patchy clay films on ped faces; common fine pores; neutral; clear, wavy boundary.

C1—38 to 46 inches, pale-brown (10YR 6/3) silt loam, dark brown (10YR 4/3) when moist; few, fine, distinct mottles that are gray (5Y 5/1) when moist; massive; slightly hard when dry, friable when moist, slightly sticky when wet; few, fine iron stains that are dark yellowish brown (10YR 4/4) when moist; few fine and medium lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C2ca—46 to 52 inches, pale-brown (10YR 6/3) silt loam, dark brown (10YR 4/3) when moist; few, fine, distinct mottles that are gray (5Y 5/1) when moist; massive; hard when dry, friable when moist, slightly sticky when wet; few, fine, distinct iron stains that are dark yellowish brown (10YR 4/4) when moist; common fine and medium lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C3—52 to 60 inches, pale-brown (10YR 6/3) silt loam, dark brown (10YR 4/3) when moist; common, fine and distinct mottles that are gray (5Y 5/1) and black (10YR 2/1) when moist; massive; hard when dry, friable when moist, slightly sticky when wet; common, fine, distinct iron stains that are yellowish brown (10YR 5/8) when moist; few fine lime segregations; calcareous; moderately alkaline.

The A horizon ranges from 6 to 12 inches in thickness and from dark gray to dark grayish brown in color. The B horizon ranges from silty clay loam to silt loam in texture and from 18 to 31 inches in thickness. The upper part ranges from brown to grayish brown in color. The soil becomes calcareous either in the lower part of the B horizon or in the C horizon. Depth to lime ranges from 30 to 50 inches. Reaction of the A and B horizons ranges from slightly acid to mildly alkaline.

Moody soils have thicker A and B horizons, are higher in content of clay, and are deeper to lime than Crofton and Nora soils. Their C horizon is more silty than that of Egan and Wentworth soils. Moody soils have a thinned A horizon and are better drained than Trent soils.

Moody-Nora complex, 2 to 6 percent slopes (MnB).—Moody soils make up 45 percent of this complex; Nora soils, 30 percent; and Trent soils, 25 percent. These gently sloping soils formed in loess and are on uplands in the southeastern corner of the county. Moody soils are on the longer and smoother side slopes and on nearly level hilltops. Nora soils are on the upper slopes and on the shorter slopes of this complex. Trent soils are in swales and on foot slopes. The profile of these three soils are the ones described as representative for their respective series.

Included in mapping were small areas of Crofton soils on the crest of slopes. Inclusions make up less than 5 percent of any given area of this mapping unit.

This complex is cultivated. Corn is the main crop, but small grain, soybeans, alfalfa, and other crops common in the area are also grown. Runoff is medium and erosion is a hazard, but the soils respond well to management. Control of erosion is the main management need. (Capability unit IIe–1, windbreak group 3, pasture group F)

Moody-Trent silty clay loams, 0 to 2 percent slopes (MtA).—Moody soils make up 50 to 60 percent of this complex, and Trent soils, 30 to 40 percent. These soils formed in loess on uplands in the southeastern corner of the county. Areas of these soils are commonly circular and are less than 20 acres in size.

The well-drained Moody soils have long, smooth slopes. The moderately well drained Trent soils are on flats and in small swales or slightly depressional areas. The Moody soil has a profile similar to the one described as representative for the series, but the surface layer is 8 to 12 inches thick. The Trent soil has a profile similar to the one described as representative for the Trent series.

Included in mapping were areas of Whitewood soils in the deeper and better defined swales and drainageways. Inclusions make up less than 10 percent of any given area of this mapping unit.

These soils are cultivated and are among the more desirable soils in the county. Corn is the main crop, but small grain, soybeans, alfalfa, and other crops common in the area are also grown. The loss of soil through runoff is slight. Maintenance of tilth, organic-matter content, and fertility is the main management need. (Capability unit I–1, windbreak group 3, pasture group F)

Nora Series

The Nora series consists of deep, well-drained, gently sloping to sloping, silty soils that formed in calcareous loess. These soils are on uplands in the southeastern corner of the county.

In a representative profile, the surface layer is dark-gray and dark grayish-brown silt loam about 7 inches thick. The subsoil, about 23 inches thick, is brown silt loam in the upper part and calcareous, pale-brown silt loam in the lower part. It is slightly hard when dry and very friable and friable when moist. There are lime segregations in the lower part that extend into the underlying material, which is calcareous, pale-brown silt loam.

Nora soils have moderately low organic-matter content and medium fertility. Surface runoff is medium, and permeability is moderate. Available water capacity is high.

Most areas of these soils are cultivated. Corn, small grain, soybeans, and alfalfa are the main crops grown. Water erosion is a hazard.

Representative profile of a Nora silt loam, in an area of Moody-Nora complex, 2 to 6 percent slopes, in a cultivated field, 354 feet south and 978 feet west of the northeast corner of sec. 33, T. 105 N., R. 51 W.

Ap—0 to 7 inches, dark-gray (10YR 4/1) and dark grayish-brown (10YR 4/2) silt loam, very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist, slightly sticky when wet; neutral; abrupt, smooth boundary.

B2—7 to 20 inches, brown (10YR 5/3) silt loam, dark brown (10YR 4/3) when moist; weak, medium and coarse, prismatic structure parting to weak, coarse, subangular blocky structure; slightly hard when dry, very friable when moist, slightly sticky when wet; thin, continuous clay films on vertical ped faces and thin, patchy clay films on horizontal ped faces; few fine pores; neutral; clear, wavy boundary.

B3ca—20 to 30 inches, pale-brown (10YR 6/3) silt loam, dark brown (10YR 4/3) when moist; common, fine and medium, faint mottles that are light brownish gray (2.5Y 6/2) when moist; weak, very coarse, prismatic structure parting to weak, very coarse, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; thin, patchy clay films on ped faces; few fine pores; many medium lime segregations; calcareous; mildly alkaline; gradual, wavy boundary.

C1—30 to 45 inches, pale-brown (10YR 6/3) silt loam, yellowish brown (10YR 5/4) when moist; many fine and few medium, faint mottles that are light brownish gray (2.5Y 6/2) and common, fine, faint mottles that are light olive brown (2.5Y 5/6) when moist; massive; slightly hard when dry, friable when moist, slightly sticky when wet; common fine and few

medium lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C2—45 to 60 inches, pale-brown (10YR 6/3) silt loam, yellowish brown (10YR 5/4) when moist; many, fine, faint mottles that are light brownish gray (2.5Y 6/2) and few, fine, faint mottles that are light olive brown (2.5Y 5/6) when moist; massive; slightly hard when dry, friable when moist, slightly sticky when wet; few medium iron concretions; few fine and medium lime segregations; calcareous; mildly alkaline.

The A horizon ranges from 4 to 7 inches in thickness. In cultivated areas the A horizon is lighter colored, because it has been mixed with the B horizon. The B horizon ranges from 12 to 30 inches in thickness and from grayish brown to brown in the upper part and from pale brown to light olive brown in the lower part. Depth to lime ranges from 10 to 30 inches. The C horizon is pale brown to light yellowish brown in color.

Nora soils are not so clayey and have a thinner A horizon than Moody soils. They are deeper to lime than the Crofton soils. They have a B horizon, which is lacking in the Crofton soils.

Nora-Crofton silt loams, 6 to 9 percent slopes (NcC).—Nora soils make up 40 percent of this complex; Crofton soils, 30 percent; and Trent soils, 15 percent. This complex is on sloping uplands in the extreme southeastern corner of the county. Nora soils are on the smoother side slopes, and Crofton soils are on the crest of slopes. Trent soils are in swales and on foot slopes. Nora soils have a thinner surface layer and subsoil and are calcareous at a shallower depth than in the profile described as representative for the Nora series. The Crofton and Trent soils have a profile that is similar to the profile described as representative for those series.

Included in mapping were areas of Moody and Whitewood soils. Moody soils are on some of the lower slopes. Whitewood soils are in the larger swales. Also included in some areas were Ethan soils in spots where loess is absent and glacial till is near the surface. Inclusions make up about 15 percent of a given area of this mapping unit.

This complex is mostly cultivated. Corn, small grain, and alfalfa are the main crops grown. These soils are susceptible to erosion and have moderately low to low organic-matter content. Intensive management practices that reduce erosion and increase the supply of organic matter are needed. (Nora part is in capability unit IIIe–1, windbreak group 3, pasture group F; Crofton part is in capability unit IVe–1, windbreak group 8, pasture group G)

Prosper Series

The Prosper series consists of deep, moderately well drained, nearly level, loamy soils on uplands. These soils are west of the East Fork of the Vermillion River. They formed in glacial till.

In a representative profile, the surface layer is dark-gray loam about 12 inches thick. The subsoil is clay loam about 22 inches thick. It is dark gray in the upper part, dark grayish brown and grayish brown in the middle part, and light brownish gray in the lower part. It is hard when dry and friable when moist. The lower part is calcareous. The underlying material is calcareous, light-gray clay loam. It is mottled yellow and olive yellow.

Prosper soils have high organic-matter content and fertility. Surface runoff is slow. Permeability is moderate in the subsoil and moderate to moderately slow in the underlying material. Most areas receive some runoff from adjacent soils. Available water capacity is high.

Most areas of these soils are cultivated. Corn, small grain, and alfalfa are the main crops grown, but all crops common in the area are suitable.

Representative profile of Prosper loam, 0 to 2 percent slopes, in a cultivated field, 240 feet north and 432 feet west of the southeast corner of sec. 29, T. 106 N., R. 54 W.

Ap—0 to 6 inches, dark-gray (10YR 4/1) loam, black (10YR 2/1) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; neutral; abrupt, smooth boundary.

A12—6 to 12 inches, dark-gray (10YR 4/1) loam, black (10YR 2/1) when moist; weak, coarse, subangular blocky structure parting to weak, fine, granular structure; slightly hard when dry, friable when moist; neutral; gradual, wavy boundary.

B1—12 to 19 inches, dark-gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) when moist; weak, medium, prismatic structure parting to weak, fine and medium, subangular blocky structure; hard when dry, friable when moist; neutral; clear, wavy boundary.

B21t—19 to 24 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, prismatic structure parting to moderate, coarse, subangular blocky structure; hard when dry, friable when moist; thin, continuous and moderately thick, patchy clay films on vertical ped faces; neutral; clear, wavy boundary.

B22t—24 to 27 inches, grayish-brown (2.5Y 5/2) clay loam, very dark grayish brown (2.5Y 3/2) when moist, dark grayish brown (2.5Y 4/2) when moist and crushed; moderate, medium, prismatic structure parting to moderate, coarse, subangular blocky structure; hard when dry, friable when moist; thin, continuous clay films and moderately thick, patchy clay films on vertical ped faces; neutral; clear, wavy boundary.

B3ca—27 to 34 inches, light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) when moist; few, fine, faint mottles that are brownish yellow (10YR 6/6); moderate, coarse, subangular blocky structure; hard when dry, friable when moist; thin, patchy clay films on vertical ped faces; many, fine and medium, distinct lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C1ca—34 to 40 inches, light-gray (2.5Y 7/2) clay loam, light brownish gray (2.5Y 6/2) when moist; common, fine, faint mottles of yellow (2.5Y 7/6) and olive yellow (2.5Y 6/6); massive; hard when dry, friable when moist; many, fine and medium, distinct lime segregations; calcareous; strongly alkaline; gradual, wavy boundary.

C2—40 to 60 inches, light-gray (2.5Y 7/2) clay loam, grayish brown (2.5Y 5/2) when moist; many, fine and medium mottles of yellow (2.5Y 7/6) and olive yellow (2.5Y 6/6); massive; slightly hard when dry, firm when moist; few fine, distinct lime segregations; calcareous; strongly alkaline.

The A horizon ranges from 7 to 14 inches in thickness and from dark gray to very dark gray in color. Texture is commonly loam, but it is silt loam in places. Clay content of the B horizon ranges from 30 to 35 percent. Texture of the B horizon commonly is clay loam, but in places there are layers of silty clay loam. Color values of 3.5 or darker when moist extend to a depth of 20 to 30 inches. Depth to lime ranges from 20 to 30 inches.

Prosper soils have a thicker A horizon and have dark colors that extend to a greater depth than in the Beadle, Clarno, and Houdek soils. Their B horizon also is less clayey than that of Beadle soils.

Prosper loam, 0 to 2 percent slopes (PrA).—This soil is in swales and slightly depressed areas. Areas of this soil commonly are long and narrow and are along small drainageways. It has the profile described as representative for the series.

Included in mapping were areas of Clarno, Houdek, and Stickney soils. Clarno and Houdek soils are on slight rises and on the outer edges of areas of this Prosper soil. Stickney soils are intermingled with the Prosper soils in some of the more deeply entrenched swales. Inclusions make up less than 15 percent of any given area of this mapping unit.

Most areas of this soil are cultivated. Corn, small grain, soybeans, and alfalfa are the main crops grown. The small amount of runoff water from adjacent areas is generally beneficial, except in years of above-normal rainfall. Maintenance of tilth and organic-matter content are management needs. (Capability unit I–1, windbreak group 1, pasture group K)

Rauville Series

The Rauville series consists of deep, poorly drained to very poorly drained, level, silty soils that have a clayey subsoil. These soils are on bottom lands. They formed in recent water-deposited sediments.

In a representative profile, the surface layer is dark-gray silty clay loam and silty clay about 23 inches thick. The subsoil is calcareous, dark-gray silty clay about 19 inches thick. It is very hard when dry and firm when moist. Gypsum crystals are common. The underlying material is calcareous, dark-gray silty clay.

Rauville soils have high organic-matter content and medium fertility. Surface runoff is very slow to ponded, and permeability is slow. These soils have a high water table and are subject to frequent flooding. Available water capacity is moderate to high.

Most areas of these soils are too wet for cultivation and are used for hay or pasture. Native vegetation consists of tall and mid grasses and sedges.

Representative profile of Rauville silty clay loam, in a meadow, 156 feet north and 100 feet west of the southeast corner of sec. 14, T. 105 N., R. 54 W.

A11—0 to 7 inches, dark-gray (N 4/0) silty clay loam, black (N 2/0) when moist; weak, fine, granular structure; hard when dry, firm when moist; calcareous; moderately alkaline; abrupt, smooth boundary.

A12gcacs—7 to 23 inches, dark-gray (5Y 4/1) silty clay, black (10YR 2/1) when moist; weak to moderate, coarse and very coarse, subangular blocky structure parting to weak, fine, granular structure; hard when dry, firm when moist; few fine gypsum crystals; few, fine and medium, distinct lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

B2gcs—23 to 42 inches, dark-gray (5Y 4/1) silty clay, black (10YR 2/1) when moist; moderate, coarse and very coarse, subangular blocky structure; very hard when dry, firm when moist; common small snail shells; common fine gypsum nests; calcareous; moderately alkaline; gradual, wavy boundary.

Cg—42 to 60 inches, dark-gray (5Y 4/1) silty clay, black (10YR 2/1) when moist; massive; very hard when dry, firm when moist; calcareous; moderately alkaline.

The A horizon ranges from 14 to 30 inches in thickness and from mildly alkaline to moderately alkaline in reaction. The B horizon ranges from silty clay loam to silty clay in texture and from weak to moderate in grade of structure. Texture of the C horizon is silty clay and silty clay loam. It commonly is stratified with lenses of coarser material and, in places, changes abruptly to sand and gravel at a depth below 40 inches.

Rauville soils are more poorly drained and have more clay at a depth below 10 inches, than Lamo and Volga soils. They are also deeper to sand and gravel than Volga soils.

Rauville silty clay loam (0 to 1 percent slopes) (Ra).—This soil is on bottom lands along streams. Areas of this soil are long and narrow and range up to 500 acres in size. A fluctuating water table is at or near the surface during spring. In addition, the low areas are subject to flooding.

Included in mapping were areas of Lamo and Volga soils, which are on slightly higher levels. Also included were spots of saline-alkali soils in some areas. Inclusions make up less than 15 percent of any given area of this mapping unit.

This soil is too wet for cultivation. It produces coarse native grasses that can be used for hay and for grazing. Grazing this soil when it is wet causes it to puddle. Introduction of reed canarygrass improves the quality of the forage. Use of drainage practices is difficult because of the lack of suitable outlets. (Capability unit Vw–1, windbreak group 10, not placed in a pasture group)

Sandy Lake Beaches

Sandy lake beaches (0 to 2 percent slopes) (Sa) consists of lake-deposited sand and gravel around lakes and large sloughs. These nearly level beach areas have a water table that is at about the same level as the water level of the lakes. The soil materials are mixed and range in color from black to pale brown. They range in texture from loamy sand to coarse sand and overlie stratified sand, gravel, and silt. Some profiles are calcareous.

Many of the areas of Sandy lake beaches support fair stands of grass. They are suited to pasture. Cultivation is not feasible, because of the pockets of coarse gravel. Some areas along Lake Madison and Brant Lake are used as cabin sites. (Capability unit VIs–1, windbreak group 10, pasture group D)

Sinai Series

The Sinai series consists of deep, well-drained, nearly level to gently sloping, clayey soils on uplands. These soils formed in clayey glacial deposits and are on broad, circular, mesalike flats and gently sloping hilltops.

In a representative profile, the surface layer is dark-gray silty clay about 7 inches thick. The silty clay subsoil, about 25 inches thick, is dark grayish brown in the upper part, grayish brown in the middle part, and light brownish gray in the lower part. It is hard when dry, firm when moist, and sticky when wet. The lower part is calcareous. The underlying material is calcareous, gray silty clay mottled with very dark brown and yellowish brown.

Sinai soils have moderate to high organic-matter content and medium fertility. Surface runoff is slow to medium, and permeability is slow. Sinai soils are slow to dry in spring and puddle if worked when they are wet. Available water capacity is moderate to high.

Nearly all areas of these soils are cultivated. Corn, small grain, flax, soybeans, and alfalfa are the main crops grown.

Representative profile of Sinai silty clay, 0 to 2 percent slopes, in a cultivated field, 140 feet south and 345 feet east of the northwest corner of sec. 33, T. 108 N., R. 53 W.

Ap—0 to 7 inches, dark-gray (10YR 4/1) silty clay, black (10YR 2/1) when moist; weak, fine, granular structure; hard when dry, firm when moist, sticky when wet; slightly acid; abrupt, smooth boundary.

B21—7 to 15 inches, dark-grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) when moist; contains tongues that are black (10YR 2/1) when moist; moderate, coarse, prismatic structure parting to moderate, medium, blocky structure; hard when dry, firm when moist, sticky when wet; thin continuous clay films on vertical ped faces; neutral; gradual, wavy boundary.

B22—15 to 26 inches, grayish-brown (2.5Y 5/2) silty clay, very dark grayish brown (2.5Y 3/2) when moist; contains tongues that are dark gray (10YR 4/1) and very dark gray (10YR 3/1) when moist; moderate, coarse, prismatic structure parting to strong, medium, blocky structure in turn parting to strong, fine and very fine, blocky structure; hard when dry, firm when moist, sticky when wet; moderately thick continuous clay films on vertical ped faces; neutral; gradual, wavy boundary.

B23—26 to 32 inches, light brownish-gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) when moist, grayish brown (2.5Y 5/2) when moist and crushed; contains tongues that are black (10YR 2/1) when moist; weak, coarse, prismatic structure parting to moderate, coarse, blocky structure in turn parting to moderate, medium and fine, blocky structure; hard when dry, firm when moist, sticky when wet; moderately thick continuous clay films on vertical ped faces; common fine distinct lime segregations; calcareous; moderately alkaline; clear, wavy boundary.

C1ca—32 to 40 inches light brownish-gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/2) when moist; many, fine, faint and distinct mottles of yellowish brown (10YR 5/8) and many, fine, distinct mottles of gray (5Y 6/1) when moist; moderate, coarse, blocky structure; hard when dry, firm when moist, slightly sticky when wet; thin patchy clay films on vertical ped faces; common, fine, distinct iron concretions; many, medium, distinct lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C2—40 to 48 inches, gray (5Y 6/1) silty clay, gray (5Y 5/1) when moist; many, fine, distinct mottles of very dark brown (10YR 2/2) and yellowish brown (10YR 5/6) when moist; weak, coarse, blocky structure parting to weak, medium and fine, blocky structure; hard when dry, firm when moist, sticky when wet; common, fine, distinct iron concretions; few, coarse, distinct lime segregations and many, medium, distinct lime segregations; calcareous; moderately alkaline; clear, wavy boundary.

C3—48 to 60 inches, gray (5Y 6/1) silty clay, gray (5Y 5/1) when moist; many, fine, distinct mottles of very dark brown (10YR 2/2), yellowish brown (10YR 5/8), and yellowish red (5YR 4/8) when moist; weak, very coarse, prismatic structure parting to weak, coarse, medium and fine, blocky structure; hard when dry, firm when moist, sticky when wet; many, medium, coarse, distinct iron concretions; common, fine and medium, distinct lime segregations; calcareous; moderately alkaline.

The A horizon ranges from silty clay loam to silty clay in texture, from 6 to 10 inches in thickness, and from dark gray to very dark gray in color. In places there are a few stones on the surface. The B horizon ranges from 15 to 35 inches in thickness and is either silty clay or silty clay loam with a clay content of 35 percent or more. Prominent tongues of material from the A horizon extend partly into or throughout the B horizon. Depth to lime ranges from 18 to 30 inches. The C horizon ranges from light brownish gray to light gray in color. It is commonly silty clay and in places is stratified with layers of silty clay loam and silt loam. The C horizon commonly shows some evidence of lamination.

Sinai soils are more clayey than Egan, Viborg, and Wentworth soils. They are better drained than Viborg and Worthing soils.

Sinai silty clay, 0 to 2 percent slopes (ScA).—This soil is on circular, mesalike flats of the uplands (fig. 15). Areas of this soil are mainly in the north-central and northwestern parts of the county. This soil has the profile described as representative for the series. In places the surface layer is silty clay loam.

Included in mapping were areas of Viborg soils in small, shallow drains. Inclusions make up less than 10 percent of any given area of this mapping unit.

Most areas of this soil are cultivated. It is suited to all the crops commonly grown in the county. Water is taken in slowly, but the soil holds it well for crop use. If this soil is cultivated when it is wet, it puddles and loses its tilth. Timeliness of cultivation is important in avoiding soil compaction. Maintenance of tilth is the main management need. (Capabiilty unit IIs–1, windbreak group 4, pasture group I)

Sinai silty clay loam, 2 to 6 percent slopes (SdB).—This gently sloping soil is on uplands, mainly in the north-central and northwestern parts of the county. Many of the areas of this soil are below and surrounding the mesalike areas of Sinai silty clay, 0 to 2 percent slopes. The surface layer is silty clay loam, and the entire profile is less clayey than the profile described as representative for the series. In addition, the subsoil is thinner and the depth to lime is less.

Included in mapping were areas of Egan, Viborg, and Wentworth soils. The Egan and Wentworth soils are on the upper slopes in some areas of this Sinai soil. The Viborg soils are in shallow swales that interlace the areas. Inclusions make up less than 15 percent of any given area of this mapping unit.

Most areas of this soil are cultivated. Corn, small grain, soybeans, flax, and alfalfa are suitable crops. This soil dries slowly. Timeliness of tillage is important in avoiding compaction and loss of tilth. Control of water erosion is the main management need, but maintenance of soil tilth is also needed. (Capability unit IIIe–3, windbreak group 4, pasture group I)

Stickney Series

The Stickney series consists of deep, moderately well drained, nearly level, silty soils that have a clayey subsoil. They formed in glacial till and are on uplands in broad swales and on low flats in the southwestern part of the county.

In a representative profile, the surface layer is dark-gray silty clay loam about 12 inches thick. Below this is a transitional layer, about 7 inches thick, of dark-gray and gray silty clay loam. The subsoil is dark-gray silty clay about 11 inches thick. It is very hard when dry and firm when moist. The underlying material is gray silty clay and silty clay loam in the upper part and calcareous, gray clay loam in the lower part.

Stickney soils have moderate organic-matter content and medium fertility. Surface runoff is slow, and permeability is slow. Available water capacity is moderate to high.

Most areas of these soils are cultivated. Corn, small grain, and alfalfa are the main crops grown. A few areas are used for hay or pasture.

Representative profile of a Stickney silty clay loam in an area of Stickney-Tetonka complex, 0 to 2 percent

Figure 15.—**An area of Sinai silty clay, 0 to 2 percent slopes, surrounded by Sinai silty clay loam, 2 to 6 percent slopes.**

slopes, in a cultivated field, 1,986 feet west and 1,030 feet north of the southeast corner of sec. 30, T. 106 N., R 54 W.

Ap—0 to 6 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; neutral; abrupt, smooth boundary.

A12—6 to 12 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) when moist; weak, very coarse and coarse, subangular blocky structure parting to weak, fine, granular structure; slightly hard when dry, friable when moist; neutral; gradual, wavy boundary.

B&A—12 to 19 inches, dark-gray (10YR 4/1) silty clay loam (B), black (10YR 2/1) when moist, and gray (10YR 5/1) bleached sand grains (A), very dark gray (10YR 3/1) when moist; weak, coarse and medium, platy structure parting to weak, coarse and medium, subangular blocky structure in turn parting to weak, fine, granular structure; slightly hard when dry, friable when moist; neutral; clear, wavy boundary.

B2t—19 to 30 inches, dark-gray (10YR 4/1) silty clay, black (10YR 2/1) when moist; moderate, medium, prismatic structure parting to strong, medium and fine, blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; moderately thick continuous clay films; neutral; clear, wavy boundary.

C1—30 to 36 inches, gray (5Y 6/1) silty clay, olive gray (5Y 4/2) when moist; many, fine and medium, distinct mottles of black (10YR 2/1) and olive (5Y 5/3) and common, fine and medium, faint mottles of dark gray (5Y 4/1) when moist; massive; very hard when dry, firm when moist, sticky and plastic when wet; common, fine, faint iron concretions; mildly alkaline; gradual, wavy boundary.

C2—36 to 48 inches, gray (5Y 6/1) silty clay loam, olive gray (5Y 5/2) when moist; many, fine and medium, faint mottles of gray (5Y 5/1), many, fine, faint mottles of black (10YR 2/1) and very dark brown (10YR 2/2), and many, fine, distinct mottles of strong brown (7.5YR 5/6) when moist; massive; hard when dry, firm when moist, sticky and plastic when wet; mildly alkaline; gradual, wavy boundary.

C3ca—48 to 60 inches, gray (5Y 6/1) clay loam, olive gray (5Y 5/2) when moist; common, fine and medium, faint mottles of gray (5Y 5/1), many, fine, faint mottles of black (10YR 2/1), and many, fine, distinct mottles of yellowish brown (10YR 5/6) when moist; massive; hard when dry, firm when moist, sticky and plastic when wet; few, coarse and common, medium, distinct lime segregations; calcareous; moderately alkaline.

The A horizon ranges from 6 to 14 inches in thickness and from silty clay loam to silt loam in texture. The B&A horizon ranges from 4 to 8 inches in thickness and from silt loam to silty clay loam in texture. The B horizon ranges from 10 to 20 inches in thickness and from dark gray to grayish brown in color. Texture of the B horizon is silty clay, silty clay loam, and clay loam that have a clay content of 35 percent or more. Depth to lime ranges from 20 to 60 inches. In places the entire C horizon is clay loam. Gypsum salts are commonly in the C horizon, immediately above the horizon of lime accumulation.

Stickney soils have a B&A horizon and are better drained than Tetonka soils. They have a more clayey B horizon than Prosper soils.

Stickney-Tetonka complex, 0 to 2 percent slopes (StA).—Stickney soils make up 50 to 70 percent of this

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complex, Tetonka soils 10 to 30 percent, and Prosper soils 10 to 20 percent. These soils are closely intermingled and are in drainageways and slightly depressional flats on uplands in the southwestern corner of the county. Areas of this complex range from 6 to 130 acres in size and commonly are long and narrow in shape. Tetonka soils are in small, circular depressions scattered throughout the areas. Prosper soils are on the outer edges of the areas. The profile of the Stickney soils is the one described as representative for the series. Tetonka and Prosper soils have a profile similar to the one described as representative for those series.

Included in mapping, mainly in the southern part of Clarno Township, were areas of moderately well drained to somewhat poorly drained, calcareous, loamy soils. They occur as narrow rims around the Tetonka soils. Ordinarily these inclusions make up less than 15 percent of any given area of this mapping unit.

Most areas of this complex are farmed. Corn, small grain, and alfalfa are the main crops grown. Runoff is slow, and water ponds in the depressions where Tetonka soils occur. In some years planting operations are delayed because of wetness. Maintenance of tilth and organic-matter content is the main management need. In addition, adequate drainage is a management need on the Tetonka soils. (Stickney part is in capability unit IIs–3, windbreak group 4, pasture group E; Tetonka part is in capability unit IIw–3, windbreak group 10, pasture group A, drained, and B, undrained)

Talmo Series

The Talmo series consists of excessively drained, gently undulating to hilly, loamy soils that formed in glacial alluvium over stratified sand and gravel. These soils are on gravelly knobs or ridges and on the steep sides of drainageways on uplands and stream terraces.

In a representative profile, the surface layer is dark-gray loam about 7 inches thick. Below the surface layer is calcareous, brown sand and gravel.

Talmo soils have low organic-matter content and fertility. Surface runoff is slow, and permeability is rapid. Available water capacity is low, and the soil is droughty.

Talmo soils are not suited to cultivation. They are well suited to pasture.

Representative profile of a Talmo loam in an area of Talmo-Delmont loams, 6 to 21 percent slopes, in a bluegrass pasture, 72 feet south and 2,230 feet east of the northwest corner of sec. 21, T. 105 N., R. 51 W.

A1—0 to 7 inches, dark-gray (10YR 4/1) loam, black (10YR 2/1) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; neutral; clear, smooth boundary.

IICca—7 to 60 inches, brown (10YR 5/3) sand and gravel, dark brown (10YR 4/3) when moist; single grained; loose; slight amount of lime as coatings on the undersides of gravel; calcareous; moderately alkaline.

The A horizon ranges from 6 to 10 inches in thickness and from dark gray to dark grayish brown in color. The texture is loam and gravelly loam. In places the A horizon is calcareous. Depth to sand and gravel ranges from 6 to 10 inches.

Talmo soils are more shallow over sand and gravel than Delmont and Enet soils. They have a coarser textured C horizon than Betts and Ethan soils, which formed in loamy glacial till containing some sand and gravel. They also have a thicker A horizon than Betts soils.

Talmo-Delmont loams, 6 to 21 percent slopes (TdE).—Talmo soils make up 40 to 50 percent of this complex, and Delmont soils, 30 to 40 percent. These undulating to hilly soils are on uplands and stream terraces and consist of gravelly knobs, ridges, and side slopes along lakes and drainageways. Areas of this complex are commonly less than 10 acres in size. There are a few larger areas along the southern side of Lake Madison, and in places slopes are more than 21 percent. Talmo soils are on the steeper and more convex parts of the slopes. Delmont soils are on side slopes below the Talmo soils or on less steep slopes above them. The profile of the Talmo soils is the one described as representative for the series. The profile of the Delmont soils is similar to the one described as representative for the series.

Included in mapping were small areas of Dempster and Enet soils. Dempster soils are on the outer edges of some areas of this complex. Enet soils are on the lower part of the slopes. Inclusions make up less than 20 percent of any given area of this mapping unit.

These soils are droughty and are not suited to cultivated crops. They are well suited to pasture. Maintaining an adequate vegetative cover is the main management need. (Capability unit VIIs–2, windbreak group 10, not placed in a pasture group)

Tetonka Series

The Tetonka series consists of deep, poorly drained, level, silty soils that have a clayey subsoil. These soils formed in alluvium washed in from adjacent slopes. They are in depressions on uplands.

In a representative profile, the surface layer is dark-gray and gray silt loam about 14 inches thick. The subsurface layer is gray silt loam about 8 inches thick. The silty clay subsoil, about 20 inches thick, is dark gray in the upper part, gray in the middle part, and light brownish gray in the lower part. The upper part is very hard when dry, very firm when moist, and sticky and plastic when wet. The underlying material is calcareous, light-gray silty clay loam.

Tetonka soils have moderate organic-matter content and medium fertility. Surface runoff is ponded, and permeability is slow. Available water capacity is high.

Tetonka soils are used for crops, hayland, and pasture. If adequately drained, they are suited to all crops common in the county.

Representative profile of Tetonka silt loam, in a cultivated field, 1,955 feet east and 865 feet north of the southwest corner of sec. 18, T. 105 N., R. 54 W.

A11—0 to 5 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) when moist; moderate, fine, subangular blocky structure parting to weak, fine, granular structure; slightly hard when dry, friable when moist; neutral; clear, smooth boundary.

A12—5 to 9 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) when moist; weak, coarse, subangular blocky structure parting to weak, fine, granular

structure; slightly hard when dry, friable when moist; neutral; clear, smooth boundary.

A13—9 to 14 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) when moist; weak, coarse, subangular blocky structure parting to weak, thick, platy structure; slightly hard when dry, friable when moist; neutral; gradual, wavy boundary.

A2—14 to 22 inches, gray (10YR 6/1) silt loam, very dark gray (10YR 3/1) when moist; moderate, medium and thick, platy structure; slightly hard when dry, friable when moist; slightly acid; clear, wavy boundary.

B21t—22 to 31 inches, dark-gray (10YR 4/1) silty clay, black (10YR 2/1) when moist; strong, coarse and medium, prismatic structure parting to strong, coarse and medium, blocky structure; very hard when dry, very firm when moist, sticky and plastic when wet; moderately thick continuous clay films; mildly alkaline; gradual, wavy boundary.

B22t—31 to 39 inches, gray (10YR 5/1) silty clay, dark gray (10YR 4/1) when moist; common, medium, distinct mottles of black (10YR 2/1) and dark yellowish brown (10YR 4/4) when moist; strong, medium, prismatic structure parting to strong, fine, blocky structure; hard when dry, firm when moist, sticky and plastic when wet; moderately thick continuous clay films on vertical ped faces; mildly alkaline; clear, smooth boundary.

B23t—39 to 42 inches, light brownish-gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/2) when moist; many, medium and coarse, distinct mottles of very dark grayish brown (2.5Y 3/2) and many, fine and medium, distinct mottles of yellowish brown (10YR 5/6) when moist; moderate, medium, blocky structure parting to moderate, fine and very fine, blocky structure; hard when dry, firm when moist; sticky and slightly plastic when wet; moderately thick continuous clay films on vertical ped faces; common fine manganese concretions; mildly alkaline; clear, wavy boundary.

Cca—42 to 60 inches, light-gray (5Y 7/1) silty clay loam, light olive gray (5Y 6/2) when moist; few, fine, distinct mottles of black (10YR 2/1) when moist; massive; slightly hard when dry, firm when moist; sticky when wet; many, fine and medium, distinct lime segregations; calcareous; moderately alkaline.

The A1 horizon ranges from 8 to 20 inches in thickness. The A2 horizon ranges from 6 to 10 inches in thickness. These horizons are slightly acid to neutral in reaction and are silt loam or silty clay loam in texture. The B horizon ranges from 15 to 30 inches in thickness and from neutral to mildly alkaline in reaction. Grade of structure ranges from moderate to strong. The C horizon commonly is silty clay loam or silty clay, but in places it is clay loam. Depth to lime ranges from 40 to 60 inches.

Tetonka soils have an A2 horizon and are less poorly drained than Worthing soils. They lack a B&A horizon and are more poorly drained than Stickney soils.

Tetonka silt loam (0 to 1 percent slopes) (Te).—This soil is in shallow, closed depressions on uplands in the southwestern corner of the county. Areas of this soil are circular in shape and range up to 25 acres in size. The profile is the one described as representative for the series.

Included in mapping were areas of Prosper soils and of a calcareous, loamy soil. These inclusions are on the outer edges of the areas of this Tetonka soil and make up less than 10 percent of any given area.

Many areas of this soil are cultivated. A few are used as hayland and for grazing. Ordinarily this soil is wet during part of each growing season. In some years planting is delayed. If adequately drained, this soil is suited to all crops commonly grown in the county. Practices that improve drainage and maintain tilth are the main management needs. (Capability unit IIw–3, windbreak group 10, pasture group A, drained, and B, undrained)

Trent Series

The Trent series consists of deep, moderately well drained, nearly level, silty soils. These soils formed in loess and are in swales and on flats on uplands in the southeastern corner of the county. Trent soils in Lake County are mapped only with Moody soils.

In a representative profile, the surface layer is dark-gray silty clay loam about 18 inches thick. The subsoil, about 32 inches thick, is dark-gray silty clay loam in the upper part, pale-brown silty clay loam in the middle part, and pale-brown silt loam in the lower part. The upper part is hard when dry and friable when moist. The underlying material is calcareous, pale-brown silt loam.

Trent soils have high organic-matter content and fertility. Surface runoff is slow, and areas of these soils occasionally receive runoff from adjacent soils. Permeability is moderately slow, and the available water capacity is high.

Nearly all areas of these soils are cultivated. Corn is the main crop, but small grain, soybeans, and alfalfa are also grown.

Representative profile of a Trent silty clay loam in an area of Moody-Nora complex, 2 to 6 percent slopes, in a cultivated field, 615 feet east and 2,142 feet north of the southwest corner of sec. 36, T. 105 N., R. 51 W.

Ap—0 to 6 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist, slightly sticky when wet; slightly acid; abrupt, smooth boundary.

A12—6 to 18 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) when moist; weak, coarse, subangular blocky structure parting to weak, fine, granular structure; slightly hard when dry, very friable when moist, slightly sticky when wet; neutral; gradual, wavy boundary.

B21—18 to 28 inches, dark-gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) when moist, very dark grayish brown (10YR 3/2) when moist and crushed; weak, medium and coarse, prismatic structure parting to weak, coarse, subangular blocky structure; hard when dry, friable when moist, slightly sticky when wet; thin continuous clay films on ped faces; neutral; clear, wavy boundary.

B22—28 to 38 inches, pale-brown (10YR 6/3) silty clay loam, dark brown (10YR 4/3) when moist; weak, very coarse, prismatic structure parting to weak, coarse and very coarse, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; thin, patchy clay films on ped faces; few small tubular pores; neutral; gradual, wavy boundary.

B3—38 to 50 inches, pale-brown (10YR 6/3) silt loam, dark brown (10YR 4/3) when moist; weak, coarse and very coarse, subangular blocky structure; slightly hard when dry, very friable when moist, slightly sticky when wet; neutral; clear, wavy boundary.

Cca—50 to 60 inches, pale-brown (10YR 6/3) silt loam, dark brown (10YR 4/3) when moist; few, fine, distinct mottles of black (N 2/0) when moist; massive; hard when dry, friable when moist, slightly sticky when wet; common, fine, faint iron stains of olive yellow (2.5Y 6/6) when moist; common medium and few

coarse lime segregations; calcareous; mildly alkaline.

The A horizon ranges from 10 to 20 inches in thickness and from dark gray to very dark gray in color. In places the texture is silt loam. The B horizon ranges from 20 to 35 inches in thickness. In places the B3 horizon is mottled with colors that range from yellowish brown to olive yellow. Depth to lime ranges from 30 to 60 inches.

Trent soils have a thicker A horizon than Moody soils. They have a more silty C horizon than Viborg soils. Trent soils are better drained than Whitewood soils.

Viborg Series

The Viborg series consists of deep, moderately well drained, nearly level to gently sloping soils that formed in silty material over glacial till. These soils are on uplands, on toe slopes, and in slight depressions and swales.

In a representative profile, the surface layer is dark-gray silty clay loam about 10 inches thick. The subsoil is silty clay loam to a depth of about 37 inches. It is dark gray in the upper part, grayish brown in the middle part, and light brownish gray in the lower part. The upper and middle parts are slightly hard when dry and friable when moist. The lower part is calcareous and hard when dry and friable when moist and has spots and stains of light olive brown and gray. The underlying material is calcareous, light brownish-gray clay loam.

Viborg soils have moderate organic-matter content and high fertility. Surface runoff is slow to medium, and permeability is moderate in the subsoil and moderate to moderately slow in the underlying material. Viborg soils occasionally receive runoff water from adjacent soils. Available water capacity is moderate to high.

Most areas of these soils are cultivated. Corn, flax, soybeans, and alfalfa are the main crops.

Representative profile of Viborg silty clay loam, 0 to 2 percent slopes, in a cultivated field, 372 feet west and 1,896 feet south of the northeast corner of sec. 31, T. 108 N., R. 51 W.

Ap—0 to 6 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) when moist; weak, coarse, medium, and fine, subangular blocky structure and weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky when wet; slightly acid; abrupt, smooth boundary.

A12—6 to 10 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) when moist; weak, coarse and medium, subangular blocky structure and weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky when wet; neutral; gradual, wavy boundary.

B1—10 to 16 inches, dark-gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) when moist; weak, medium and coarse, prismatic structure parting to weak, medium and coarse, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; neutral; gradual, wavy boundary.

B21—16 to 21 inches, grayish-brown (2.5Y 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) when moist; weak, coarse and medium, prismatic structure parting to weak, coarse and medium, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; neutral; gradual, wavy boundary.

B22—21 to 29 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; few to common, fine, faint mottles of light olive brown (2.5Y 5/3); weak to moderate, coarse, prismatic structure parting to moderate, coarse and medium, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; few fine lime concretions; neutral; clear, wavy boundary.

B3ca—29 to 37 inches, light brownish-gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; few, fine, faint mottles of gray (5Y 5/1) when moist; moderate, coarse, medium, and fine, blocky structure; hard when dry, friable when moist, sticky when wet; few, fine, faint iron stains of light olive brown (2.5Y 5/6) when moist; few, fine, distinct iron concretions; many fine and medium lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

IIC1ca—37 to 50 inches, light brownish-gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) when moist; common, fine and medium, distinct mottles of gray (5Y 5/1) when moist; moderate, coarse, medium, and fine, blocky structure; hard when dry, firm when moist, sticky when wet; common fine iron stains of yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) when moist; common fine iron concretions; common fine and medium lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

IIC2—50 to 60 inches, light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) when moist; common, fine, distinct mottles of black (10YR 2/1) and gray (5Y 5/1) when moist; moderate, coarse, medium, and fine, blocky structure; hard when dry, firm when moist, sticky when wet; common to many fine iron stains of yellowish brown (10YR 5/6) and yellowish red (5Y 4/6) when moist; common fine iron concretions; few fine lime segregations; calcareous; moderately alkaline.

The A horizon ranges from 8 to 16 inches in thickness and from silt loam to silty clay loam in texture. The B horizon ranges from 20 to 46 inches in thickness. The very dark grayish-brown or darker moist colors extend to a depth of 20 inches or more. Depth to lime ranges from 24 to 35 inches. Depth to the clay loam IIC horizon ranges from 28 to 60 inches. In places there is a silty C horizon between the B3ca and IIC horizon.

Viborg soils are not so well drained as Egan and Wentworth soils and have a thicker A horizon. They are better drained than Whitewood soils. Their C horizon is less silty than that of Trent soils, and they lack the sand and gravel of the Graceville soils.

Viborg silty clay loam, 0 to 2 percent slopes (VbA).—This soil is in swales and slight depressions. Areas of this soil are long and narrow and range up to 100 acres in size. Runoff water received from adjacent soils generally is beneficial in years of normal rainfall. The profile is the one described as representative for the series.

Included in mapping were small areas of Whitewood soils at the bottom of some of the more deeply entrenched swales. Inclusions make up less than 15 percent of any given area of this mapping unit.

Most areas of this soil are cultivated. It is well suited to corn, small grain, flax, soybeans, and alfalfa. Maintenance of tilth, organic-matter content, and fertility is the main management need. (Capability unit I–1, windbreak group 1, pasture group K)

Viborg-Egan silty clay loams, 2 to 6 percent slopes (VgB).—Viborg soils make up 50 to 60 percent of this complex, and Egan soils, 30 to 40 percent. These soils are on uplands throughout the county, east of the East Fork of the Vermillion River. These soils are closely intermingled. Viborg soils are on the lower slopes and in swales; Egan soils are on the upper part of the slopes. The profile of the Viborg soils has a slightly thinner surface layer than that of the profile described as representative for the series. Egan soils have a profile that is similar to the profile described as representative for their series.

Included in mapping were areas of Wentworth and Whitewood soils. Wentworth soils are on the mid and upper parts of slopes with Egan soils. Whitewood soils are on the lower part of the larger swales. Inclusions make up less than 10 percent of any given area of this mapping unit.

Most areas of this complex are cultivated. The soils are well suited to all crops common in the county. Control of water erosion is the main management need. (Capability unit IIe–1, windbreak group 1, pasture group K)

Volga Series

The Volga series consists of somewhat poorly drained and poorly drained, nearly level, silty soils that are moderately deep over sand and gravel. These soils formed in alluvium and are on bottom lands along the East Fork of the Vermillion River and along Battle Creek.

In a representative profile, the surface layer is very dark gray silty clay loam about 17 inches thick. Below this is a transitional layer, about 11 inches thick, that consists of calcareous, dark-gray sandy clay loam that is mottled pale olive. It is slightly hard when dry and friable when moist. The underlying material is dark-gray loamy sand and gravel. It is calcareous in the upper part.

Volga soils have moderate to high organic-matter content and medium fertility. Surface runoff is very slow. Permeability is moderately slow in the upper part of the profile but is rapid in the underlying material. Available water capacity is low to moderate. Volga soils have a fluctuating water table and are subject to flooding.

Some areas of these soils are cultivated and are planted mainly to corn and small grain. Most areas are small and are used for pasture or hay.

Representative profile of Volga silty clay loam, in a pasture, 765 feet east and 216 feet south of the northwest corner of sec. 15, T. 105 N., R. 51 W.

A11—0 to 9 inches, very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) when moist; weak, very coarse, subangular blocky structure parting to weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky when wet; calcareous; mildly alkaline; gradual, wavy boundary.

A12—9 to 17 inches, very dark gray (5Y 3/1) silty clay loam, black (5Y 2/1) when moist; weak, coarse, subangular blocky structure parting to weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky when wet; calcareous; moderately alkaline; gradual, wavy boundary.

ACgca—17 to 28 inches, dark-gray (5Y 4/1) sandy clay loam, black (5Y 2/1) when moist; few, fine, distinct mottles of pale olive (5Y 6/4) when moist; weak, coarse, subangular blocky structure parting to weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky when wet; common fine lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

IIC1g—28 to 36 inches, dark-gray (5Y 4/1) loamy sand, black (5Y 2/1) when moist; few, fine, distinct mottles of pale olive (5Y 6/4) when moist; massive; slightly sticky when dry, friable when moist, slightly sticky when wet; common fine lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

IIC2g—36 to 60 inches, dark-gray (5Y 4/1) loamy sand and gravel, very dark gray (5Y 3/1) when moist; single grained; loose; moderately alkaline.

The A horizon ranges from loam to silty clay loam in texture. The AC horizon commonly is stratified and ranges from silty clay loam to loamy sand in texture. Depth to the IIC horizon of loamy sand and gravel ranges from 20 to 40 inches. The IIC horizon ranges from dark gray to light olive brown in color and in places is stratified with thin bands of sandy clay loam.

Volga soils are more shallow over sand and gravel than Lamo and Rauville soils. They lack the clayey B horizon of Rauville soils and are better drained than Rauville soils. Volga soils are more poorly drained than Dempster and Enet soils, which are also moderately deep over sand and gravel.

Volga silty clay loam (0 to 2 percent slopes) (Vo).—This nearly level soil is on bottom lands. Most areas of this soil are long and narrow along stream channels or are small and circular within oxbows of stream channels. The areas range from 3 to 50 acres in size.

Included in mapping were small areas of Lamo and Rauville soils. These inclusions are in low areas and make up less than 15 percent of any given area of this mapping unit.

Wetness is the major limitation of this soil. It is subject to flooding and has a fluctuating water table. If adequately drained, it is suited to corn and small grain. Some areas are better suited to pasture because of their small size and their location near creek channels. (Capability unit IIw–2, windbreak group 2, pasture group A, drained, and B, undrained)

Wentworth Series

The Wentworth series consists of deep, well-drained, nearly level to gently sloping, silty soils on uplands. They formed in silty glacial drift and are closely associated with the Egan soils.

In a representative profile, the surface layer is dark grayish-brown silty clay loam about 7 inches thick. The subsoil is silty clay loam about 27 inches thick. The upper part is brown, and the lower part is light brownish gray and is calcareous. It is slightly hard to hard when dry and friable when moist. The underlying material is calcareous, light brownish-gray silty clay loam. It is mottled and is stained with yellowish brown and dark brown.

Wentworth soils have moderate organic-matter content and medium to high fertility. Surface runoff is slow to medium, and permeability is moderate in the subsoil and moderate to moderately slow in the underlying material. Available water capacity is high.

Most areas of these soils are cultivated. They are suited to all the crops commonly grown in the county.

Representative profile of a Wentworth silty clay loam in an area of Egan-Wentworth silty clay loams, 2 to 6 percent slopes, in a cultivated field, 2,475 feet east and 300 feet north of the southwest corner of sec. 35, T. 108 N., R. 52 W.

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky when wet; slightly acid; abrupt, smooth boundary.

B21—7 to 15 inches, brown (10YR 5/3) silty clay loam, very dark grayish brown (10YR 3/2) when moist, dark brown (10YR 3/3) when moist and crushed; weak, coarse and medium, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; thin, patchy clay films on vertical ped faces; slightly acid; gradual, wavy boundary.

B22—15 to 26 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) when moist; moderate, coarse and medium, prismatic structure parting to weak, coarse

and medium, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; thin patchy clay films on vertical ped faces; few, fine distinct iron stains of dark brown (7.5YR 4/4) when moist; few fine, distinct iron concretions; neutral; clear, wavy boundary.

B3ca—26 to 34 inches, light brownish-gray (2.5YR 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; common, fine and medium, distinct mottles of olive gray (5Y 5/2) when moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky structure; hard when dry, friable when moist, slighty sticky when wet; many, fine, distinct iron stains of dark yellowish brown (10YR 4/4) when moist and few, fine and medium iron stains of reddish brown (2.5YR 4/4) when moist; common fine and medium iron concretions; many fine and medium lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C1ca—34 to 48 inches, light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) when moist; weak, coarse and medium, subangular blocky structure; hard when dry, friable when moist, slightly sticky when wet; common, fine and medium, distinct iron stains of dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) when moist and few, fine and medium, distinct iron stains of dark brown (7.5YR 4/4) when moist; common fine and medium iron concretions; common fine and medium lime segregations; calcareous; moderately alkaline; gradual, wavy boundary.

C2—48 to 60 inches, light brownish-gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) when moist; weak, coarse and medium, subangular blocky structure; hard when dry, friable when moist, slightly sticky when wet; common, fine and medium, distinct iron stains of dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) when moist and few, fine and medium, distinct iron stains of dark brown (7.5YR 4/4) when moist; common, fine and medium, distinct iron concretions; few fine and medium lime segregations; calcareous; moderately alkaline.

The A horizon ranges from 5 to 10 inches in thickness and from dark gray to dark grayish brown in color. Texture of the A horizon commonly is silty clay loam, but it is silt loam in places. The B horizon ranges from 15 to 33 inches in thickness and from silty clay loam to silt loam in texture. The upper part is brown or grayish brown in color. Depth to lime ranges from 18 to 30 inches. The C horizon is silty clay loam or silt loam and commonly contains thin lenses of loam or sandy loam. Clay loam glacial till is at a depth of more than 40 inches, but ordinarily the thinly stratified silty materials of the C horizon extend to a depth of 5 feet or more.

Wentworth soils have a more silty C horizon than Egan soils. Their C horizon is thinly stratified with loamy material and is less silty than Moody and Nora soils. Wentworth soils have a thinner A horizon and are better drained than Viborg soils.

Wentworth-Egan silty clay loams, 0 to 2 percent slopes (WeA).—Wentworth soils make up 50 to 60 percent of this complex, and Egan soils, 30 to 40 percent. The soils are closely intermingled in areas that commonly are less than 20 acres in size. Wentworth soils are on the more nearly level parts of the areas, and Egan soils are on convex slight rises. The surface layer of both soils is slightly thicker than that in the profile described as representative for their respective series. Depth to lime ranges from 24 to 30 inches.

Included in mapping were areas of Viborg soils in slightly depressional areas and in swales. Inclusions make up about 10 percent of any given area of this mapping unit.

Most areas of this complex are cultivated and are well suited to all crops grown in the county. These soils are friable and are easy to work. Maintenance of tilth, organic-matter content, and fertility is the main management need. (Capability unit I-1, windbreak group 3, pasture group F)

Whitewood Series

The Whitewood series consist of deep, somewhat poorly drained, nearly level, silty soils. These soils formed in silty glacial drift and in sediments washed in from adjacent soils. They are in swales, broad drainageways, and slight depressions on uplands.

In a representative profile, the surface layer is dark-gray silty clay loam about 16 inches thick. The subsoil is silty clay loam about 27 inches thick. It is dark gray in the upper part, gray in the middle part, and light olive gray in the lower part. It is slightly hard to hard when dry, friable when moist, and slightly sticky when wet. There are dark yellowish-brown and yellowish-brown spots in these layers and in the underlying material. The underlying material is calcareous, light olive-gray silty clay loam.

Whitewood soils have high organic-matter content and fertility. Surface runoff is slow, and the areas receive runoff from adjacent soils. Permeability is moderately slow, and the available water capacity is moderate to high.

Most areas of these soils are cultivated, but some are used for pasture. If adequately drained, these soils are suited to corn and small grain.

Representative profile of Whitewood silty clay loam, in a cultivated field, 2,570 feet east and 570 feet south of the northwest corner of sec. 10, T. 105 N., R. 52 W.

Ap—0 to 7 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) when moist; cloddy parting to weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky when wet; slightly acid; abrupt, smooth boundary.

A12—7 to 16 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) when moist; weak, coarse and medium, subangular blocky structure parting to weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky when wet; neutral; gradual, wavy boundary.

B21—16 to 25 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) when moist; common, fine, faint mottles of dark yellowish brown (10YR 4/4) when moist; moderate, coarse and medium, prismatic structure parting to weak, coarse, medium, and fine, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; moderately alkaline; gradual, wavy boundary.

B22g—25 to 32 inches, gray (5Y 5/1) silty clay loam, dark gray (5Y 4/1) when moist; many, fine, distinct mottles of dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) when moist; moderate, coarse and medium, prismatic structure parting to moderate, coarse and weak, medium and fine, subangular blocky structure; hard when dry, friable when moist, slightly sticky when wet; moderately alkaline; clear, wavy boundary.

B3g—32 to 43 inches, light olive-gray (5Y 6/2) silty clay loam, olive gray (5Y 5/2) when moist; common, fine, distinct mottles of very dark brown (10YR 2/2) when moist and many, fine, distinct mottles of yellowish brown (10YR 5/6 and 10YR 5/8) when moist; weak, very coarse and coarse, prismatic structure parting to weak, coarse and medium, subangular blocky structure; hard when dry, friable when moist, slightly sticky when wet; moderately alkaline; clear, wavy boundary.

Cgca—43 to 60 inches, light olive-gray (5Y 6/2) silty clay loam, olive gray (5Y 5/2) when moist; many, fine and medium, distinct mottles of yellowish brown (10YR 5/6 and 10YR 5/8) when moist and common, fine, distinct mottles of very dark brown (10YR 2/2) when moist; massive; hard when dry, friable when moist, slightly sticky when wet; few, fine, distinct iron concretions; common fine and few medium lime segregations; calcareous; moderately alkaline.

The A horizon ranges from 12 to 20 inches in thickness and from silty clay loam to silt loam in texture. The B horizon ranges from 20 to 38 inches in thickness and from weak to moderate in grade of structure. Depth to lime ranges from 30 to 50 inches. In places the silty C horizon changes abruptly to clay loam glacial till at a depth below 40 inches.

Whitewood soils are more poorly drained than Viborg soils. They have a less clayey B horizon and are not so poorly drained as Worthing soils. They are less calcareous than Badus soils.

Whitewood silty clay loam (0 to 2 percent slopes) (Wh).—This soil is in swales, slight depressions, and large drainageways. Areas range in size from 3 to 150 acres.

Included in mapping were areas of Badus and Viborg soils. These soils are along the edges of the areas or on slight rises within the areas. Inclusions make up less than 20 percent of any given area of this mapping unit.

Many areas of this soil are cultivated. Some are used as hayland and as pasture. The areas receive runoff water from adjacent soils and are occasionally flooded. If this soil is flooded during spring, late-sown crops such as sudangrass, millet, and soybeans are substituted for corn. Practices that reduce the hazard of flooding are the main management need. (Capability unit IIw-1, windbreak group 2, pasture group A, drained, and B, undrained)

Worthing Series

The Worthing series consists of deep, poorly drained, level, silty soils that have a clayey subsoil. These soils formed in sediments washed in from adjacent soils. They are in flat, enclosed depressions on uplands in all parts of the county.

In a representative profile, the surface layer is dark-gray silty clay loam about 10 inches thick. The subsoil is silty clay about 38 inches thick. It is dark gray in the upper part and gray in the lower part. It is hard to very hard when dry, firm when moist, and sticky and plastic when wet. The underlying material is calcareous, gray silty clay loam.

Worthing soils have high organic-matter content and fertility. Surface runoff is received from adjacent soils, and these soils are ponded. A water table is present but commonly is 5 feet or more below the surface. Permeability is slow, and the available water capacity is moderate to high.

If adequately drained, these soils are suited to corn and small grain. Many areas are used for hay and pasture and, unless drained, are better suited to this use than to others. Native vegetation includes marsh grasses, sedges, and reeds.

Representative profile of Worthing silty clay loam, in a tame pasture, 1,760 feet east and 1,275 feet south of the northwest corner of sec. 4, T. 105 N., R. 53 W.

A1—0 to 10 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) when moist; weak, coarse, subangular blocky structure parting to moderate, fine, blocky and weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; slightly acid; clear, wavy boundary.

B21t—10 to 20 inches, dark-gray (10YR 4/1) silty clay, black (10YR 2/1) when moist; common, fine, distinct mottles of dark brown (7.5YR 4/4) when moist; weak, medium, prismatic structure parting to moderate, fine and very fine, blocky structure; hard when dry, firm when moist, sticky and plastic when wet; neutral; gradual, wavy boundary.

B22t—20 to 32 inches, gray (10YR 5/1) silty clay, black (10YR 2/1) when moist; few, fine, distinct mottles of dark brown (7.5YR 4/4) when moist; moderate, medium, prismatic structure parting to strong, fine, blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; common fine and medium manganese concretions; neutral; gradual, wavy boundary.

B23t—32 to 43 inches, gray (10YR 5/1) silty clay, black (10YR 2/1) when moist; common, fine, faint mottles of yellowish brown (10YR 5/6) when moist; strong, fine and very fine, blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; neutral; gradual, wavy boundary.

B3g—43 to 48 inches, gray (10YR 5/1 and 5Y 6/1) silty clay, black (10YR 2/1) and gray (5Y 5/1) when moist; many, fine and medium, distinct mottles of olive (5Y 4/4) when moist; moderate, fine and very fine, subangular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; mildly alkaline; clear, wavy boundary.

Cgca—48 to 60 inches, gray (5Y 6/1) silty clay loam, gray (5Y 5/1) when moist; many, medium, distinct mottles of pale olive (5Y 6/4) and dark brown (7.5YR 4/4) when moist; massive; hard when dry, firm when moist, slightly sticky when wet; common fine lime segregations; calcareous; moderately alkaline.

The A horizon ranges from 8 to 20 inches in thickness, from dark gray to very dark gray in color, and from silt loam to silty clay in texture. In places there is a mat of undecomposed stems, leaves, and organic matter on the surface. The B horizon ranges from 25 to 45 inches in thickness and from gray to very dark gray in color. There are a few nests of gypsum crystals in the B3 horizon, and in places the B3 horizon is calcareous. Depth to lime commonly is greater than 38 inches. Texture of the mottled and gleyed C horizon is silty clay loam, silty clay, and clay loam.

Worthing soils are more poorly drained and have a more clayey B horizon than Whitewood soils. They are deeper over lime than Baltic soils.

Worthing silty clay loam (0 to 1 percent slopes) (Wo).—This soil is in flat, enclosed depressions in all parts of the county (fig. 16). Areas of this soil are circular and range in size from 5 to 180 acres.

Included in mapping were areas of Badus soils on the outer edges of the depressions. Inclusions make up less than 10 percent of any given area of this mapping unit.

Wetness is the major limitation in the use of this soil. If adequately drained, it can be farmed, but planting and crop maturity may still be delayed by excess moisture. This soil is well suited to pasture and hay. Grazing this soil when it is wet causes it to puddle. (Capability unit IIIw-1, windbreak group 10, pasture group A, drained, and B, undrained)

Use and Management of the Soils

This section discusses the use and management of the soils for crops and pasture, for trees and shrubs in field windbreaks, for wildlife, and for engineering purposes. Predicted average yields also are given for the principal crops under two levels of management.

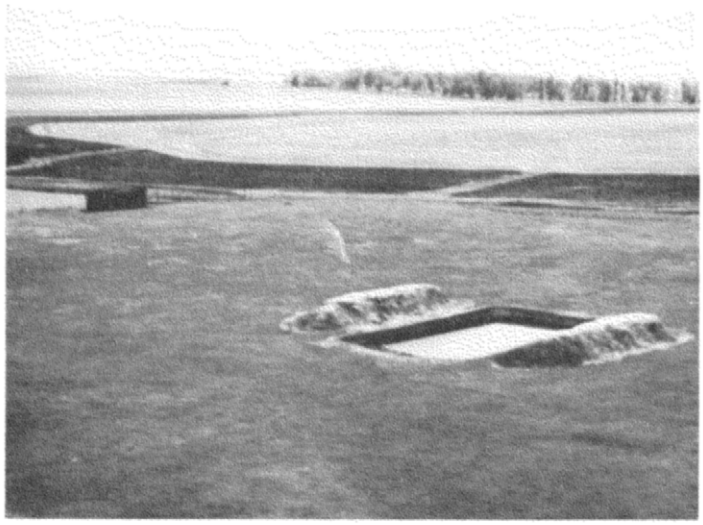

Figure 16.—A dug-out pound in Worthing silty clay loam.

Management of Cropland [3]

Cropland makes up about 78 percent of the total land area of this county. Corn is the main crop. Oats, soybeans, flax, and alfalfa are the other principal crops grown.

The cultivated soils range from sandy loam to silty clay. Areas of soils used for crops need management that conserves moisture, controls erosion, and maintains or improves tilth and fertility.

Conserving moisture and controlling erosion

Lack of moisture often limits the production of crops in this county. Protection from soil blowing is needed for such soils as the Henkin and Sinai if they are fallowed or fall plowed during droughty seasons.

Such soils as the Beadle, Clarno, Egan, Moody, Nora, and Wentworth are subject to water erosion, especially if row crops are planted up and down hill rather than on the contour.

The following management practices help to control erosion and conserve moisture.

Conservation cropping system.—A good cropping system provides adequate residue, which helps to control erosion, maintains organic matter content, and conserves moisture. Many systems include such soil-improving crops as legumes and tame grasses that help to keep the soil in good physical condition and to maintain its fertility. A conservation cropping system is one of the effective practices used to control losses from soil blowing on such soils as the Sinai and Henkin and losses from water erosion on such soils as the Wentworth.

Crop residue use.—This practice is desirable on all soils used for crops in the county. It consists of leaving enough of the crop residue on the surface or incorporating it into the surface layer so that the soil is protected from blowing and washing during the critical seasons. This practice also returns organic matter to the soil, helps to maintain fertility, improves tilth, and aids in the absorption and retention of rainfall.

Contour stripcropping.—This practice consists of growing strips of close-sown crops separated by strips of clean-tilled crops or strips left fallow, all on the contour (fig. 17). This reduces water erosion and is especially effective on the Moody and Nora soils.

Contour farming.—This practice consists of cultivating land in such a way that land preparation, planting, and cultivation are done on the contour. This includes following established grades of terraces, diversions, or contour strips. This practice reduces water runoff and is effective on such soils as the Beadle, Clarno, Egan, Moody, Nora, and Wentworth.

Terraces.—Terraces shorten the length of slope and thereby reduce soil losses and conserve moisture on such soils as the Egan, Moody, and Wentworth. Contour farming is generally performed in conjunction with terracing or stripcropping. Care is needed when terracing soils that have a gravel substratum, such as the Dempster and Enet, especially when using an alinement of terraces.

Emergency tillage.—This practice consists of roughening the soil surface by listing, ridging, duck-footing, or chiseling. It is needed on all soils that have insufficient crop residue or vegetation to provide protection from soil blowing, especially on Henkin and Sinai soils during droughty seasons.

Grassed waterways.—Grassed waterways are broad, grass-covered channels that are so graded that runoff water does not erode the soil (fig. 18). The need for grassed waterways is most apt to occur in cultivated areas of Clarno, Egan, Moody, Nora, and Wentworth soils. Before a gradient terrace is built, a grassed waterway should be established to receive the discharge water from the terrace.

Maintaining tilth and fertility

Management that maintains organic-matter content and plant nutrients at levels favorable to plant growth is needed on all cultivated soils in the county. Using

Figure 17.—Contour stripcropping on Sinai silty clay loam, 2 to 6 percent slopes.

[3] By WALTER N. PARMETER, conservation agronomist, Soil Conservation Service.

Figure 18.—**Grassed waterway on Egan-Beadle complex, 6 to 9 percent slopes.**

sweetclover as a green-manure crop and plowing it down when it is only 8 to 12 inches tall add organic matter and nitrogen, improve tilth, and leave sufficient moisture for the next crop.

Chemical fertilizer is used to maintain a balanced supply of plant nutrients. The kind of soil and the treatment it has received in former years generally affect the kind and amount of fertilizer needed to produce good crops and vegetative cover for the land. However, the kind and amount needed for a specified crop should be determined by a soil test. Crops on most soils in the county give good response to the addition of chemical fertilizer, farm manure, or a combination of these. Crofton, Delmont, Enet, and Ethan are soils commonly low in fertility.

Calcareous soils, such as the Badus, Crofton, Ethan, Lamo, and Rauville, are more deficient in available phosphorus than other soils, but they generally contain enough potassium to meet the needs of most plants. Soils that receive large amounts of residue from grain sorghum or other nonleguminous crops need additions of nitrogen when the next crop is planted. Add 20 pounds of nitrogen for each ton of residue left on the land. Nitrogen deficiencies are most apt to be evident in years of above-average rainfall.

Management that emphasizes minimum tillage greatly reduces the number of operations performed in producing a crop. Excessive tillage breaks down soil structure, so that the soil tends to puddle if it is wet and to crust when it dries. It takes in less water and air and stores less moisture for use by plants. The plow or disk can be replaced by a machine that stirs the soil, kills weeds, and plants the crop in the same operation without turning under the litter from the preceding crop. Weeds can also be controlled during this planting operation by the use of chemical sprays. Reducing the number of operations reduces the cost of machinery, labor, and fuel, and there is less compaction of the soil.

Frequent tillage of such soils as the Sinai and Worthing causes the formation of a tillage pan immediately below the plow or blade depth. Avoiding tillage if the soil is wet and alternating the depth of tillage help to prevent the formation of a tillage pan. Chiseling every third or fourth year and using deep-rooted legumes and grasses help to correct an existing pan.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or for engineering.

In the capability system, all kinds of soil are grouped at three levels, the capability class, subclass, and unit. These are discussed 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, defined as follows:

Class I soils have few limitations that restrict their use.

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

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

Class IV soils have very severe limitations that reduce the choice of plants, 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 largely to pasture, woodland, or wildlife.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture, woodland, or wildlife.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture, woodland, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, or

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water supply, or to esthetic purposes. (None in Lake County)

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 but not in Lake County, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, although they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management (*7*). Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-2 or IIIe-5. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages the capability units in Lake County are described and suggestions for the use and management of the soils are given. The soil series represented in a capability unit are named, but this does not mean that all the soils in any given series are in that capability unit. Also, if a soil is a member of a complex, its capability may differ from the capability when the soil is mapped alone. This is because a complex of soils is treated as a whole in its management for cropland. To find the capability unit of any given mapping unit, refer to the "Guide to Mapping Units."

CAPABILITY UNIT I–1

This unit consists of deep, nearly level, well drained and moderately well drained, loamy and silty soils of the Clarno, Davis, Egan, Graceville, Houdek, Moody, Prosper, Trent, Viborg, and Wentworth series. These soils are on uplands and stream terraces.

Fertility is medium to high, and tilth is good. Permeability is moderate to moderately slow. Available water capacity is moderate to high. Runoff is slow, and erosion is not a hazard. Davis, Graceville, Prosper, Trent, and Viborg soils are on parts of the landscape that receive some runoff from adjacent slopes. This extra water generally is beneficial. Maintenance of fertility, organic-matter content, and tilth is the main management need.

All crops common in the county are suitable. Corn, oats, flax, soybeans, and alfalfa are the main crops.

Returning crop residue to the soil helps to maintain fertility, organic-matter content, and tilth. If these soils are fertilized, row crops can be grown continuously.

CAPABILITY UNIT IIe–1

This unit consists of deep, gently sloping, well drained and moderately well drained, silty soils of the Egan, Ethan, Moody, Nora, Viborg, and Wentworth series. These soils formed in silty materials and are on uplands. Slopes are long and smooth.

Fertility is medium to high, and tilth is good. Permeability is moderate to moderately slow, and the available water capacity is high. Runoff is medium, and the soils are susceptible to erosion. Control of water erosion is the main management need.

These soils are suited to all the crops commonly grown in the county. Corn, oats, soybeans, and alfalfa are the main crops.

Use of crop residue, green-manure crops, contour farming, and grass-covered waterways helps to control erosion as well as to maintain fertility and organic-matter content. Terracing and contour stripcropping also help to control erosion.

CAPABILITY UNIT IIe–2

This unit consists of deep, gently sloping and gently undulating, well drained and moderately well drained, loamy and silty soils of the Clarno, Davis, Ethan, and Houdek series. These soils are on uplands and stream terraces. Slopes are short and irregular in some areas.

Fertility is medium to high in all except the Ethan soils, which have low fertility. Permeability is moderate to moderately slow. Available water capacity is moderate to high. Runoff is medium. Management needs include control of erosion and maintenance of organic-matter content and fertility.

Corn, oats, flax, soybeans, and alfalfa are the main crops. Sorghums and tame grasses are also available.

Use of crop residue, contour farming or contour stripcropping; and grass-covered waterways helps to control erosion and to maintain organic-matter content and fertility. Terracing is desirable on the longer slopes where the cropping sequence consists of continuous row crops. If these practices are not practical to apply in areas where slopes are short and irregular, the alternatives to help control erosion are the use of green-manure crops, strong emphasis on crop-residue use, and the use of a cropping system that utilizes close-sown crops and grasses and legumes.

CAPABILITY UNIT IIs–1

This unit consists of deep, nearly level, well-drained, loamy and clayey soils of the Beadle and Sinai series.

Fertility is medium, and the available water capacity is moderate to high. Permeability is moderately slow in the Beadle soils and slow in the Sinai soils. The soils dry out slowly, and in some years planting is delayed. Cultivating the soils when they are wet causes them to puddle. Maintenance of good tilth is the main management need.

Corn, oats, flax, and alfalfa are the main crops. Soybeans and tame grasses are also suitable crops.

Management that maintains good tilth includes returning crop residue to the soil, varying the depth of plowing to reduce compaction, avoiding tillage when the soil is too wet or too dry, and avoiding compaction from unnecessary traffic by livestock and machinery.

CAPABILITY UNIT IIs–2

This unit consists of nearly level, well-drained, silty and loamy soils of the Dempster and Enet series. These soils are moderately deep over sand and gravel and are on terraces and uplands.

Fertility is low to medium, and organic-matter content is low to moderate. Permeability is moderate to moderately rapid, and the available water capacity is low to moderate. The soils are somewhat droughty, and Enet soils are subject to blowing in dry years. Management needs include conservation of moisture, maintenance of organic-matter content and fertility, and control of soil blowing.

Corn, small grain, soybeans, flax, sorghums, and tame grasses are suitable crops. Alfalfa is not so well suited to these somewhat droughty soils.

Use of crop residue, use of grasses in the cropping system, and application of animal manure help to conserve moisture and to maintain organic-matter content and fertility. These practices also help to control soil blowing.

CAPABILITY UNIT IIs–3

This unit consists of the Stickney part of the Stickney-Tetonka complex, 0 to 2 percent slopes. This soil is deep, nearly level, and moderately well drained and has a clayey subsoil. It is in swales and on upland flats.

Permeability is slow, but the available water capacity is moderate to high. Runoff is slow, and farming operations are occasionally delayed by wetness. Maintenance of tilth is the main management need.

All crops common in the county are suitable. Corn, small grain, and alfalfa are the main crops grown.

Use of crop residue, use of legumes and grasses in the cropping system, and application of manure help to maintain and improve tilth, organic-matter content, and fertility.

CAPABILITY UNIT IIw–1

This unit consists of deep, nearly level, somewhat poorly drained and poorly drained, silty soils of the Badus and Whitewood series. These soils are on uplands in swales and drainageways.

These soils have medium to high fertility and good tilth. Permeability is moderately slow, but the available water capacity is moderate to high. Wetness from occasional flooding is the main hazard. Damage to crops is seldom severe, although planting and tilling may be delayed.

Corn, oats, soybeans, flax, and alfalfa are the main crops. Catch crops, such as sudangrass and millet, are used in years when wetness prevents planting of corn at the usual time. If drainage practices have not been established, the soils are better suited to grazing and to use as hayland than to most other uses.

Management that retards runoff from adjacent soils helps to reduce the wetness. Drainage practices are required to reduce the hazard of flooding. Use of crop residue and of legumes in the cropping system helps to maintain fertility and good tilth.

CAPABILITY UNIT IIw–2

This unit consists of deep, somewhat poorly drained and poorly drained soils of the Lamo and Volga series. These are nearly level, silty soils on bottom lands. Volga soils are underlain by sand and gravel at a moderate depth.

Permeability is moderately slow. The available water capacity is high in the Lamo soils but is low to moderate in the Volga soils. Planting and tillage are frequently delayed because of wetness from occasional flooding and the rise of a fluctuating water table into the root zone during winter and spring. In dry years, moisture from the water table benefits crop growth.

Corn, grain sorghum, and soybeans are suitable crops. Alfalfa also is suitable, but in some years the water table restricts the root zone. If drainage practices have not been established, the soils are better suited to grazing and to use as hayland than to most other uses.

Use of crop residue, use of legumes in the cropping system, and application of manure help to maintain tilth and fertility. Shallow surface drains help to remove trapped surface water. Open ditches and tile drains help to control the level of the water table.

CAPABILITY UNIT IIw–3

This unit consists of deep, level, poorly drained, silty soils of the Tetonka series in upland depressions. The subsoil is silty clay.

Permeability is slow, but the available water capacity is high. Use of this soil is limited by its wetness and its slow permeability.

If adequately drained, this soil is suited to all crops commonly grown in the county. If wetness delays the planting of small grain and corn, soybeans or such catch crops as sudangrass and millet are suitable substitutes. If drainage practices have not been established, the soils are better suited to grazing and to use as hayland than to most other uses.

Use of crop residue helps to maintain tilth and fertility. Management of adjacent soils that reduces runoff helps to reduce wetness. Where suitable outlets are available, surface drains help to remove ponded water.

CAPABILITY UNIT IIIe–1

This unit consists of deep, sloping, well-drained, silty soils of the Egan and Nora series. These soils formed in silty materials. Slopes are smooth and long.

Tilth is good, but organic-matter is moderately low and fertility is medium. Permeability is moderate to moderately slow, and the available water capacity is high. These soils are highly susceptible to erosion. Control of erosion is the main management need, but maintenance of tilth, organic-matter content, and fertility is also needed.

Corn, small grain, and alfalfa are the main crops, but all crops common in the county are suitable.

In addition to use of crop residue, contour farming or contour stripcropping, terracing, and grass-covered

waterways are needed to help control erosion. The alternative is to limit row crops and to use close-sown crops and grasses and legumes in the cropping system. These measures also help to maintain tilth, organic-matter content, and fertility.

CAPABILITY UNIT IIIe–2

The unit consists of deep, undulating, well-drained, loamy soils of the Clarno series. Most areas are slightly to moderately eroded.

Fertility is medium, and organic-matter content is moderate. Tilth is good. Permeability is moderate to moderately slow, and the available water capacity is high. Control of erosion is the main management need. Maintenance of tilth, organic-matter content, and fertility is also needed.

All crops common in the county are suited. Corn, oats, and alfalfa are the main crops. Soybeans and flax are also grown.

Use of crop residue and manure and the use of grasses and legumes in the cropping system help to maintain tilth, organic-matter content, and fertility. These measures also help to control erosion. Contour stripcropping, terracing, and grass-covered waterways also are needed to help control erosion. Where slopes are short and irregular, the alternative to terracing and contouring is to limit row crops and make maximum use of close-sown crops in the cropping system.

CAPABILITY UNIT IIIe–3

This unit consists of deep, gently undulating, well-drained, loamy and clayey soils of the Beadle and Sinai series. These soils are on uplands. Many areas are slightly eroded.

Fertility is medium, and organic-matter content is moderate. Permeability is moderately slow to slow, and the available water capacity is moderate to high. Runoff is medium. Control of erosion is the main management need. Maintenance of organic-matter content and fertility and improvement of tilth are also needed.

Soils in this unit are well suited to oats, sorghums, alfalfa, sweetclover, and tame grasses. They are less well suited to corn and soybeans.

Use of crop residue, manure, fertilizer, and grasses and legumes in the cropping system helps to maintain tilth, organic-matter content, and fertility. These practices, along with use of contour farming or terracing and grass-covered waterways, also help to control erosion. In places where contour farming and terracing are difficult to apply, the alternative is to limit row crops and use a maximum of close-sown crops in the cropping system.

CAPABILITY UNIT IIIe–4

Henkin loam, 3 to 9 percent slopes, is the only soil in this unit. This is a deep, gently sloping to sloping, well-drained soil on uplands. It has a surface layer of loam and a subsoil of sandy loam.

Fertility is low to medium, and organic-matter content is moderately low. Water is taken in easily and is released readily to plants. Permeability is moderately rapid, and the available water capacity is low to moderate. This soil is droughty. Management needs include control of both soil blowing and erosion, conservation of moisture, and the maintenance of organic-matter content and fertility.

All crops common in the county are suitable, but early-maturing small grain is more suitable.

Use of crop residue, green-manure crops, and grasses and legumes in the cropping system helps to control soil blowing, conserve moisture, and maintain or improve organic-matter content and fertility. Terracing, contour stripcropping, and grass-covered waterways help to control erosion.

CAPABILITY UNIT IIIe–5

This unit consists of deep, undulating, well-drained, loamy soils of the Beadle series. These soils are on uplands. The subsoil is more clayey than the surface layer and is firm when moist. Many areas are slightly to moderately eroded.

Tilth is only fair, and losses in fertility and organic-matter content have occurred in eroded areas. Permeability is moderately slow, and the available water capacity is moderate to high; however, the subsoil releases moisture slowly to plants. Control of erosion is the main management need. Improvement of tilth, organic-matter content, and fertility are also needed.

Oats, sorghum, alfalfa, sweetclover, and tame grasses are better suited crops than corn and soybeans. Early-maturing crops are desirable.

Use of crop residue, manure, fertilizer, and grasses and legumes in the cropping system helps to improve tilth, organic-matter content, and fertility. Terracing, contour farming, and grass-covered waterways help to control erosion. In areas where mechanical practices are difficult to apply, limiting the use of clean-tilled crops helps to control erosion.

CAPABILITY UNIT IIIs–1

This unit consists only of Dempster silt loam, 2 to 6 percent slopes. This is a gently sloping, well-drained, silty soil that is moderately deep over sand and gravel.

This soil has good tilth, medium fertility, and moderate organic-matter content. Permeability and available water capacity are moderate, but the soil is somewhat droughty because of the underlying sand and gravel. Conservation of moisture and control of erosion are needed.

Corn, small grain, and alfalfa are the main crops, but all crops common in the county are suitable. Early-maturing small grain is better suited than corn and other deep-rooted crops.

The use of crop residue, contour farming or contour stripcropping, and grass-covered waterways helps to conserve moisture and control erosion. Terraces are also desirable, but channel cuts are limited by the moderate depth to sand and gravel.

CAPABILITY UNIT IIIs–2

Henkin loam, 0 to 3 percent slopes, is the only soil in this unit. This is a deep, nearly level, well-drained soil on uplands. It has a surface layer of loam and a subsoil of sandy loam.

Fertility is low to medium, and organic-matter content is moderately low. Water is taken in easily and is released readily to plants. Permeability is moderately rapid, and the available water capacity is low to mod-

erate. This soil is droughty. Management needs include the conservation of moisture, maintenance of organic-matter content and fertility, and control of soil blowing.

All crops common in the county are suitable, but early-maturing small grain is better suited.

Use of crop residue, green-manure crops, and grasses and legumes in the cropping system helps to conserve moisture, maintain or improve organic-matter content and fertility, and control soil blowing. Wind stripcropping also helps to control soil blowing.

CAPABILITY UNIT IIIw–1

Worthing silty clay loam is the only soil in this unit. This is a deep, level, poorly drained soil in upland depressions. It has a subsoil of silty clay.

Permeability is slow, and runoff is ponded. Wetness is the main limitation in using this soil. Maintenance of tilth is a management need.

If this soil is adequately drained, it is well suited to corn and small grain.

Control of runoff water from adjacent soils and arrangement of row direction help to improve drainage. In areas where suitable outlets are available, field drains and open ditches also help to improve drainage. Using crop residue and avoiding tillage when the soil is wet help to maintain tilth. When applying nitrogen fertilizer, it is more effective to use several light applications rather than a single heavy application on this wet soil.

Where drainage practices have not been established, this soil is used for grazing, as hayland, or for wildlife habitat. Quality of the forage produced can be improved by the introduction of tall wheat grass and reed canarygrass.

CAPABILITY UNIT IIIw–2

Baltic silty clay loam is the only soil in this unit. This is a deep, level, poorly drained to very poorly drained, calcareous soil in large depressions of the uplands. It has a subsoil of silty clay.

Organic-matter content is high, and fertility is medium. Availability of plant nutrients is affected by the high content of lime. Permeability is slow, and the available water capacity is high. Runoff is ponded. A fluctuating water table causes lime and gypsum to rise in the profile of this soil. Wetness and maintenance of tilth and fertility are management limitations.

If adequately drained and fertilized, this soil is suited to corn, small grain, and alfalfa. Rye is better suited on these high-lime soils than other small grain. Soybeans and catch crops, such as sudangrass and millet, are substitute crops for corn and small grain in years when planting is delayed by wetness.

Use of crop residue and manure helps to maintain or improve tilth and to maintain fertility. Keeping tillage operations to a minimum helps to avoid soil compaction and benefits tilth. Control of runoff from adjacent soils helps to reduce wetness. If suitable outlets are available, surface drains help to improve drainage.

If drainage practices have not been established, the Baltic soils are used for grazing, as hayland, or for wildlife habitat. Quality of the forage produced can be improved by the introduction of tall wheatgrass and reed canarygrass.

CAPABILITY UNIT IVe–1

This unit consists of the Crofton part of Nora-Crofton silt loams, 6 to 9 percent slopes. This is a deep, sloping, well-drained, calcareous, silty soil that formed in loess on uplands. In cultivated areas, the thin surface layer is mixed with the light-colored underlying materials.

Fertility and organic-matter content are low. Permeability is moderate, and the available water capacity is high. Controlling erosion and increasing organic-matter content and fertility are management needs.

Suitable crops are corn, small grain, sorghums, soybeans, alfalfa, sweetclover, and tame grasses.

Intensive management is needed to control erosion. Use of terraces, contour farming or contour stripcropping, and grass-covered waterways helps to control erosion. Use of crop residue, manure, and grasses and legumes in the cropping system during 50 percent or more of the sequence time also helps to control erosion and to improve organic-matter content and fertility.

CAPABILITY UNIT IVe–2

This unit consists of deep, rolling, well-drained, loamy soils of the Clarno series. These soils are on uplands. Cultivated areas are slightly to moderately eroded.

Fertility is medium. Organic-matter content is moderate, except in areas that are moderately eroded. Permeability is moderate to moderately slow, and the available water capacity is high. Control of erosion is the main management need.

Suitable crops are corn, small grain, alfalfa, sweetclover, and tame grasses.

Use of terracing, contour stripcropping, grass-covered waterways, crop residue, and grasses and legumes in the cropping system helps to control erosion as well as to maintain fertility and organic-matter content. The need for terraces is less critical in areas that are seeded to grasses and legumes.

CAPABILITY UNIT IVe–3

This unit consists of soils of the Dempster and Delmont series. These are well-drained and somewhat excessively drained, silty and loamy soils that are moderately deep and shallow over sand and gravel.

Fertility is medium to low, and organic-matter content is moderate. Permeability is moderate to moderately rapid in the soils and rapid in the underlying sand and gravel. Available water capacity is moderate in the Dempster soils and low in the Delmont soils, making these soils somewhat droughty. Management needs include control of soil blowing and erosion, conservation of moisture, and the improvement of fertility and organic-matter content.

Small grain, flax, and tame grasses are better suited crops than corn and other deep-rooted crops.

Use of crop residue, contour farming, grass-covered waterways, and manure helps to control erosion, conserve moisture, and maintain or improve organic-matter content and fertility. Use of grass and close-sown crops in the cropping system during much of the sequence time is also desirable.

CAPABILITY UNIT IVe–4

This unit consists of deep, undulating, well-drained, silty and loamy soils of the Egan and Ethan series. These soils are on uplands that are slightly to severely eroded.

Most of the moderately and severely eroded areas are Ethan soils. The surface layer of the soils in this unit is thinner than that described as representative for their respective series.

Permeability is moderate to moderately slow, and the available water capacity is high. Fertility is low to medium. Organic-matter content is low in the Ethan soils and moderate in the Egan soils. Control of erosion is a critical management need on these soils. Improvement of fertility and organic-matter content are also needed.

Suitable crops are corn, sorghum, small grain, flax, alfalfa, sweetclover, and bromegrass. It is not advisable to grow clean-tilled row crops in successive years, because of the erosion hazard.

Use of terracing, contour farming or contour stripcropping, and grass-covered waterways helps to control erosion. In places where these practices are not practical because of short, irregular slopes, an alternative is the use of grasses and legumes in the cropping system at least half of the time. Emphasis on use of crop residue, green-manure crops, and animal manure helps to improve fertility and organic-matter content in addition to helping control erosion.

CAPABILITY UNIT IVs–1

This unit consists of the Delmont part of the Delmont-Talmo loams, 2 to 6 percent slopes. This is a gently undulating, somewhat excessively drained, loamy soil that is shallow over sand and gravel.

Fertility is low, and organic-matter content is moderate. Permeability is moderately rapid, and the available water capacity is low. This soil is droughty, and conservation of moisture is the main management need. Control of erosion and improvement of organic-matter content and fertility are also important needs.

Early-maturing crops, such as small grain, sweetclover, and tame grasses, are suitable crops. This soil is too droughty for corn, sorghums, and alfalfa.

Use of crop residue and contour farming helps to conserve moisture and control erosion. Green-manure crops and animal manure help to improve organic-matter content and fertility. Good pasture management helps to conserve moisture and control erosion on areas in native and tame grasses.

CAPABILITY UNIT Vw–1

Rauville silty clay loam is the only soil in this unit. This is a level, poorly drained to very poorly drained, calcareous soil that has a clayey subsoil and is on bottom lands.

This soil is frequently flooded and has a fluctuating water table. Permeability is slow, and runoff is very slow to ponded. Wetness is the main limitation.

Most areas of this soil are used for grazing and as hayland. The dominant coarse grasses are more apt to be palatable to grazing animals early in summer. Quality of the forage produced can be improved by the introduction of tall wheatgrass and reed canarygrass. Grazing during winter and early in spring causes the soil to pack and puddle and the grass cover to deteriorate. Use of drainage practices generally is not feasible.

CAPABILITY UNIT VIe–1

This unit consists of deep, rolling to steep, well-drained to excessively drained, loamy soils of the Betts, Clarno, and Ethan series. These soils are on uplands. Betts soils have a surface layer less than 5 inches thick.

Fertility of the Betts and Ethan soils is low, and the organic-matter content of those soils is low to moderately low. Clarno soils have medium fertility, and the organic-matter content is moderate. Permeability is moderate to moderately slow, and the available water capacity is high. Control of erosion is the main management need.

These soils are too erodible for use as cropland and should be cultivated only enough to establish trees or to reestablish grass. They are well suited to pasture or hay, except for the steeper areas, where it is difficult to use haying machinery. Many areas are in native grass. Native grasses include little bluestem, big bluestem, switchgrass, green needlegrass, bearded wheatgrass, and indiangrass. Tame grasses and alfalfa are grown in some of the less steep areas. Pasture management that keeps the grass vigorous and furnishes good plant cover and mulch helps to control erosion.

CAPABILITY UNIT VIs–1

Sandy lake beaches is in this unit. This land type consists of mixed soils and soil materials that are mostly sandy and are underlain by stratified sand, gravel, and silt. Many areas are nearly level, but some have hummocky relief. A fluctuating water table is at variable depths.

Areas of this land type are droughty and are subject to soil blowing where a vegetative cover is lacking. They are well suited to pasture or hayland. Pasture management that maintains a good vegetative cover helps to conserve moisture and control erosion.

CAPABILITY UNIT VIs–2

This unit consists of gently undulating and undulating, excessively drained, loamy soils of the Talmo series. These soils are underlain by sand and gravel at a depth of less than 10 inches.

Fertility and organic-matter content are low. Permeability is rapid, and the available water capacity is low. Conservation of moisture and control of soil blowing are management needs.

This soil is too droughty for crops. It is well suited to grazing or hayland. Many areas are in native grasses. Native grasses include needle-and-thread, little bluestem, side-oats grama, blue grama, and threadleaf sedge. Management that maintains a good grass cover helps to conserve moisture and control erosion.

CAPABILITY UNIT VIIs–1

This unit consists of deep, undulating to steep, stony soils of the Ethan series. These soils are on uplands.

Permeability is moderate to moderately slow, and the available water capacity is high. Stoniness limits the use of these soils and prevents the use of farm machinery. Many areas are steep and are subject to erosion.

These soils are well suited to grazing. Most areas are in native grass. Native grasses include big bluestem, little bluestem, indiangrass, switchgrass, porcupinegrass, green needlegrass, and bearded wheatgrass. Management that maintains a good cover helps to control erosion.

CAPABILITY UNIT VIIs–2

This unit consists of soils of the Delmont and Talmo series. These are undulating to hilly, excessively drained

and somewhat excessively drained, loamy soils that are shallow over sand and gravel.

Fertility is low, and organic-matter content is low to moderate. Permeability is rapid in the Talmo soils and moderately rapid in the Delmont soils. The available water capacity is low. These soils are too droughty and erodible for use as cropland. The hilly slopes limit the use of farm machinery.

These soils are well suited to grazing. Many areas are in native grasses. Native grasses include needle-and-thread, little bluestem, side-oats grama, and threadleaf sedge. Management that maintains a good grass cover helps to conserve moisture and control erosion.

Predicted Yields

Table 2 lists, for each soil judged suitable for crops, the predicted average yields per acre of corn, oats, soybeans, flax, and alfalfa. The predictions are for dry-farmed soils under two levels of management, common (A) and high (B).

Yield predictions shown in columns A of table 2 are those that can be expected under management that is customarily practiced in the county. Under such management, conservation crop rotations are lacking or are poorly planned, barnyard manure or green-manure crops are not extensively used, sloping soils are farmed up and down hill, the poorer soils are farmed along with the better soils, and commercial fertilizers are not used regularly as needed.

The predicted yields shown in columns B are those that can be expected under careful and intensive management, which includes use of recommended conservation cropping systems; application of needed mechanical conservation practices; use of commercial fertilizers in kinds and amounts recommended by soil tests and the kind of crop to be grown; effective control of weeds; and use of barnyard manure, green-manure crops, and legumes and grasses to maintain organic-matter content and improve soil fertility and tilth.

The yield predictions in table 2 are based on information supplied by representative farmers throughout the county, by the county agriculture extension agent, by the South Dakota Crop and Livestock Reporting Service, and by Soil Conservation Service personnel in Lake County. Yields are based on planted acres rather than harvested acres and are averaged out to include years of below-normal, and above-normal precipitation. These predicted yields are subject to change because of use of new crop varieties and improved farming methods.

Use and Management of the Soils for Pasture [4]

Most of Lake County was once vegetated with grass. About 14 percent is now used for pasture. Small isolated areas are still in native grass and are used for grazing. Most of the pastures used for grazing consist of tame grasses seeded either for permanent pasture or as rotation hay and pasture in a conservation cropping system.

[4] By WALTER N. PARMETER, conservation agronomist, Soil Conservation Service.

Many of the pastures are grazed too closely during all or part of the grazing season. This decreases plant vigor and forage production, reduces the density of the stand, and increases runoff and erosion.

Well-managed pastures of tame grasses produce two to four times as much forage as a poorly managed pasture. In addition, the need to conserve moisture and control erosion is also benefited by good management.

Pasture management includes grazing according to the kinds and amounts of forage produced on different kinds of soil. Sufficient height of grass is left in the fall to replenish roots with plant food, to catch snow during the winter for moisture, and to prevent erosion.

Pasture management also includes the use of fertilizers as needed, rotation grazing, brush and weed control, development of livestock watering facilities (fig. 19) to distribute grazing, pasture furrows to retard runoff, clipping to encourage uniform grazing, and reseeding to suitable species for stand improvement.

The soils of Lake County are grouped into nine pasture groups, which are described in the following paragraphs. In each description are shown important soil characteristics, suitable species, and management peculiar to that pasture group. Only those soils suitable for tame pastures are placed in a pasture group.

The letters used to identify the pasture groups are not alphabetic, because they are part of a statewide system and not all of these letters are used in Lake County. The names of the soil series represented are mentioned in each group, but this does not mean that all the soils of a given series are in the group. To find the pasture group in which a given soil has been placed and the page on which it is described, turn to the "Guide to Mapping Units."

PASTURE GROUP A

In this group are deep and moderately deep, somewhat poorly drained to very poorly drained, silty soils of the Badus, Baltic, Lamo, Tetonka, Volga, Whitewood, and Worthing series. These soils have above-average available water from beneficial flooding or from the water table. Drainage has been established. Production of forage is two to three times that produced by similar-textured soils on uplands. New growth is consistently available throughout the grazing season.

Suitable tame grasses and legumes are smooth bromegrass, intermediate wheatgrass, Kentucky bluegrass, reed canarygrass, Garrison creeping foxtail, alfalfa, and sweetclover. Intermediate wheatgrass is especially well suited. Alfalfa and sweetclover are compatible with smooth bromegrass and intermediate wheatgrass.

PASTURE GROUP B

This group consists of deep, somewhat poorly drained to very poorly drained, silty soils of the Badus, Baltic, Lamo, Tetonka, Volga, Whitewood, and Worthing series. These soils are in depressions and are flooded by run-in water from adjacent soils or have a high water table. Runoff is ponded long enough to limit the kinds of suited grasses. Fall is the most suitable time for seedbed preparation.

Suitable grasses are reed canarygrass and Garrison creeping foxtail. Where drainage practices are established on these soils, they are in pasture group A.

TABLE 2.—*Predicted average yields per acre of principal dryfarmed crops under two levels of management*

[Yields in columns A are those to be expected under management commonly practiced; yields in columns B are those to be expected under improved management. Only soils suitable for the specified crops are listed]

Soil	Corn		Oats		Soybeans		Flax		Alfalfa	
	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*
Badus silty clay loam	36	54	39	53	12	22	10	15	2.0	2.6
Baltic silty clay loam	35	52	37	51	12	22	10	15	2.0	2.6
Beadle clay loam, 0 to 2 percent slopes	38	50	40	65	15	23	12	20	1.9	2.8
Beadle clay loam, 2 to 6 percent slopes	35	47	37	62	13	19	10	18	1.6	2.6
Beadle clay loam, 6 to 9 percent slopes	31	41	32	56	11	16	8	15	1.3	2.3
Clarno loam, 0 to 2 percent slopes	40	65	42	70	15	25	14	22	2.0	3.0
Clarno loam, 2 to 6 percent slopes	38	63	40	68	14	21	12	20	1.7	2.7
Clarno loam, 6 to 9 percent slopes	30	55	34	60	11	16	9	18	1.2	2.4
Clarno-Ethan loams, 2 to 6 percent slopes	34	59	35	57	13	19	11	19	1.6	2.6
Clarno-Ethan loams, 6 to 9 percent slopes	26	51	30	50	11	16	8	17	1.2	2.3
Clarno-Ethan loams, 9 to 16 percent slopes	25	45	30	47	10	15	7	16	1.2	2.2
Davis loam	50	71	45	70	20	29	15	24	2.5	3.5
Delmont-Talmo loams, 2 to 6 percent slopes	20	35	22	38	10	16	7	11	1.0	1.8
Delmont-Talmo loams, 6 to 9 percent slopes	18	33	20	32	8	14	6	10	.8	1.4
Dempster silt loam, 0 to 2 percent slopes	45	68	45	70	18	28	14	22	2.2	3.0
Dempster silt loam, 2 to 6 percent slopes	39	59	42	65	16	26	10	14	1.8	2.7
Dempster-Delmont complex, 6 to 9 percent slopes:										
Dempster part	31	49	31	50	12	20	9	13	1.3	1.9
Delmont part	18	33	20	32	8	14	6	10	.8	1.4
Egan silty clay loam, 6 to 9 percent slopes	47	67	42	65	14	22	10	19	2.0	3.3
Egan-Beadle complex, 0 to 2 percent slopes:										
Egan part	51	75	49	80	20	30	16	25	2.3	3.7
Beadle part	38	50	40	65	15	23	12	20	1.9	2.8
Egan-Beadle complex, 2 to 6 percent slopes:										
Egan part	49	72	47	75	18	26	14	23	2.3	3.6
Beadle part	36	45	36	62	13	19	10	10	1.6	2.6
Egan-Beadle complex, 6 to 9 percent slopes:										
Egan part	47	67	42	65	14	22	10	19	2.0	3.3
Beadle part	31	40	32	54	11	16	8	12	1.3	2.3
Egan-Ethan complex, 2 to 6 percent slopes:										
Egan part	49	72	47	75	18	26	14	23	1.6	2.6
Ethan part	22	45	28	48	12	18	9	16	1.4	2.5
Egan-Ethan complex, 6 to 9 percent slopes, eroded:										
Egan part	30	57	32	54	13	21	10	18	1.6	2.6
Ethan part	19	42	25	45	11	17	8	13	1.3	2.4
Egan-Viborg silty clay loams, 0 to 3 percent slopes	52	75	50	80	20	32	16	26	2.5	4.0
Egan-Wentworth silty clay loams, 2 to 6 percent slopes	49	72	47	75	18	26	14	23	2.3	3.6
Enet loam, 0 to 2 percent slopes	35	50	35	55	16	24	11	16	1.5	2.1
Graceville silty clay loam	50	72	49	75	17	30	14	22	2.6	3.5
Henkin loam, 0 to 3 percent slopes	35	50	30	45	10	15	11	16	1.5	2.1
Henkin loam, 3 to 9 percent slopes	31	45	26	40	8	13	9	13	1.3	1.9
Houdek loam, 2 to 6 percent slopes	38	63	38	66	13	23	12	20	2.1	2.9
Houdek-Prosper loams, 0 to 3 percent slopes	40	65	45	68	17	25	13	21	2.3	3.2
Lamo silty clay loam	40	60	38	55	14	26	11	16	2.4	3.4
Moody-Nora complex, 2 to 6 percent slopes	50	73	48	75	18	28	14	24	2.4	3.6
Moody-Trent silty clay loams, 0 to 2 percent slopes	53	79	52	82	21	33	16	26	2.5	4.0
Nora-Crofton silt loams, 6 to 9 percent slopes:										
Nora part	35	60	35	65	14	22	10	19	1.7	2.6
Crofton part	23	40	30	45	10	14	6	14	1.6	2.4
Prosper loam, 0 to 2 percent slopes	47	66	48	70	18	26	14	22	2.4	3.5
Sinai silty clay, 0 to 2 percent slopes	45	63	47	65	18	23	12	20	2.4	3.4
Sinai silty clay loam, 2 to 6 percent slopes	43	61	45	63	17	22	11	19	2.3	3.3
Stickney-Tetonka complex, 0 to 2 percent slopes	38	60	40	65	17	25	13	20	2.2	3.2
Tetonka silt loam	38	55	40	60	15	25	11	16	2.2	3.2
Viborg silty clay loam, 0 to 2 percent slopes	53	76	52	82	20	32	16	26	2.5	4.0
Viborg-Egan silty clay loams, 2 to 6 percent slopes	51	74	49	76	19	28	15	24	2.5	3.8
Volga silty clay loam	30	50	35	55	12	22	10	15	2.3	3.2
Wentworth-Egan silty clay loams, 0 to 2 percent slopes	52	75	50	80	20	30	16	25	2.6	3.8
Whitewood silty clay loam	45	70	45	70	18	28	12	22	2.2	3.5
Worthing silty clay loam	38	55	40	55	14	25	11	16	2.1	2.9

Figure 19.—**Dug-out pond and pasture furrows on Egan-Beadle complex, 6 to 9 percent slopes.**

PASTURE GROUP D

In this group are well-drained and somewhat excessively drained, loamy and silty soils of the Delmont, Dempster, and Enet series and Sandy lake beaches. Dempster and Enet soils are moderately deep over sand and gravel, and Delmont soils are shallow over sand and gravel. Permeability is moderate and moderately rapid. Available water capacity is limited because of the underlying sand and gravel. These soils are droughty.

Suitable grasses and legumes are intermediate wheatgrass, pubescent wheatgrass, crested wheatgrass, smooth bromegrass, Russian wildrye, and sweetclover. Crested wheatgrass and Russian wildrye are not suitable where slopes are more than 5 percent. Sweetclover is suitable to seed together with any of these grasses. Successful establishment of Russian wildrye is best obtained by seeding on fallow.

PASTURE GROUP E

In this group are deep, well drained and moderately well drained, silty and loamy soils that have a clayey subsoil. It is made up of soils of the Beadle and Stickney series on uplands. Permeability is slow and moderately slow, and the available water capacity is moderate to high. Plant roots penetrate the subsoil with difficulty and are concentrated in the more friable surface layer.

Suitable grasses and legumes are intermediate wheatgrass, Russian wildrye, pubescent wheatgrass, western wheatgrass, crested wheatgrass, and sweetclover. Pubescent wheatgrass and crested wheatgrass are more resistant to drought but generally are less palatable. Sweetclover is suitable to seed with any of these grasses. Russian wildrye is well suited to grazing late in summer and in fall.

PASTURE GROUP F

In this group are deep, well-drained, silty and loamy soils of the Clarno, Egan, Ethan, Houdek, Moody, Nora, Prosper, Trent, Viborg, and Wentworth series. Permeability is moderate to moderately slow, and the available water capacity is high. Fertility, organic-matter content, and available water capacity are all favorable for tame grasses. Soil reaction ranges from slightly acid to mildly alkaline except in eroded areas of the Ethan soils, which are moderately alkaline.

Also included as the less dominant soils in complexes are the thinly developed, excessively drained, calcareous soils of the Betts series and the moderately well drained soils of the Prosper, Trent, and Viborg series.

Suitable grasses and legumes are smooth bromegrass, intermediate wheatgrass, crested wheatgrass, Russian wildrye, alfalfa, and sweetclover. Crested wheatgrass seeded alone is not desirable where slopes are in excess of 5 percent. Russian wildrye is not suited to the Betts soils.

PASTURE GROUP G

This group consists of the Crofton part of Nora-Crofton silt loams, 6 to 9 percent slopes. This is a deep, well-drained, calcareous, silty soil. It is high in content of lime and low in fertility and organic-matter content. Permeability is moderate, and the available water capacity is high. Surface runoff is medium.

Suitable grasses and legumes are smooth bromegrass, intermediate wheatgrass, pubescent wheatgrass, alfalfa, and sweetclover. Crested wheatgrass is not desirable on this sloping soil, because it is a bunchgrass and does not provide adequate cover to control erosion. Use of nitrogen fertilizer helps to achieve satisfactory forage production.

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PASTURE GROUP H

This group consists of deep, well-drained, loamy soils of the Henkin series. These soils have a sandy loam subsoil. Permeability is moderately rapid, and available water capacity is low to moderate. Organic-matter content is moderately low, and fertility is low to medium. These soils are susceptible to soil blowing.

Suitable grasses and legumes are smooth bromegrass, crested wheatgrass, switchgrass, alfalfa, and sweetclover. Switchgrass is a warm-season grass and is best established by planting in spring.

PASTURE GROUP I

In this group are deep, well-drained, clayey soils of the Sinai series. Permeability is slow, and the soils take in water slowly except following dry periods when the soils are cracked. Plant roots penetrate the subsoil with some difficulty because the soils are hard when dry and firm when moist.

Suitable grasses and legumes are Russian wildrye, crested wheatgrass, Siberian wheatgrass, western wheatgrass, smooth bromegrass, intermediate wheatgrass, alfalfa, and sweetclover. Seedbed preparation should be avoided when the soil is wet to prevent soil compaction and loss of tilth.

PASTURE GROUP K

In this group are deep, moderately well drained, loamy and silty soils of the Davis, Egan, Graceville, Prosper, and Viborg series. Also included are the well-drained Egan soils, which occur as the less dominant soil in a complex with Viborg soils. These soils have moderate to high organic-matter content and medium to high fertility. Permeability is moderate to moderately slow, and the available water capacity is moderate to high. Runoff is slow, and the soils receive runoff from adjacent soils. The additional moisture is sufficient to produce 1½ to 2 times the forage produced on well-drained soils.

Suitable grasses and legumes are smooth bromegrass, intermediate wheatgrass, Kentucky bluegrass, reed canarygrass, Garrison creeping foxtail, alfalfa, and sweetclover.

Use of the Soils for Windbreaks [5]

Less than 1 percent of Lake County is native timberland. These areas are along the edges of permanent lakes. Broad-leaved species, such as cottonwood, green ash, American elm, oak, and willow, make up most of the tree species present. Shrubs include chokecherry, plum, juneberry, rose, and shrub willows. These species have little value as woodland products, but they do furnish ideal spots for recreation and wildlife.

Farmstead and feedlot windbreaks are established around buildings to protect the farm family, livestock, buildings, and yards from damaging winds and snow. Farmstead windbreaks also furnish protection to wildlife, fruit trees, and gardens. Most farmsteads have windbreaks, but many of them have been grazed and show signs of deterioration. Many of the farmstead windbreaks consist of one or two species of trees, but a mixture of several species, both broad-leaved and conifer, is more desirable. Supplemental plantings, pruning, and elimination of grazing generally are needed to make existing windbreaks more effective.

Field windbreaks normally consist of narrow plantings made at intervals of 20 to 40 rods across the cropland, depending on the erodibility of the soil. Their purpose is to protect cropland from wind and to hold snow on the fields. They also provide food and cover for wildlife. Many wide field windbreaks were planted under the Prairie States Forestry Project during the years from 1935 to 1942. Most of these survived and are effective in reducing soil blowing and in holding drifting snow.

Windbreak planting sites need careful preparation, and the trees planted need to be protected from weed competition, fire, insects, rodents, disease, and grazing. Cultivation is an important management practice in establishing a good windbreak (fig. 20). Information about the establishment and care of trees can be obtained from the local office of the Soil Conservation Service.

Some soils are well suited to many trees and shrubs, some are well suited to only a few, and some soils are not suited to any trees and shrubs. Soils in Lake County are placed in eight windbreak suitability groups.

Growth characteristics of various trees and shrubs differ among these windbreak suitability groups. Table 3 gives the estimated condition and height of various trees and shrubs at 20 years of age for each windbreak group except group 10. Soils in windbreak group 10 are not suited to windbreak planting. The estimates in table 3 are based on measurements and observations of established plantings that have been given adequate care. This information can be used as a guide in planning a windbreak. The criteria for condition classes are as follows:

Good.—One or more of the following conditions generally apply: leaves or needles are normal in color and growth; there are small amounts of dead wood (tops, branches, and twigs) within the live crowns; evidence of disease, insect, and climatic damage is limited; there may be slight evidence of suppression or stagnation.

Fair.—One or more of the following conditions generally apply: leaves or needles are obviously abnormal in color and growth; there are substantial amounts of deadwood (tops, branches, and twigs) within the live crowns; evidence of moderate disease, insect, or climatic damage is obvious; definite suppression or stagnation exists; current year's growth is obviously less than normal.

Poor.—One or more of the following conditions generally apply: leaves or needles are very abnormal in color and growth; there are very large amounts of deadwood (tops, branches, and twigs) within the live crowns; evidence of extensive disease, insect, and climatic damage is obvious; plants show the effect of severe stagnation, suppression, or decadence; current year's growth is essentially negligible.

Windbreak groups in Lake County are described in the following paragraphs. The windbreak groups are not numbered consecutively, because they are part of a statewide system. The names of the soil series represented are mentioned in each group, but this does not mean that all the soils of a given series are in the group. To find

[5] By ELMER L. WORTHINGTON, woodland conservationist, Soil Conservation Service.

Figure 20.—**Cleanly cultivated second-year windbreak on Egan-Ethan complex, 6 to 9 percent slopes, eroded.**

the windbreak group of any given mapping unit, refer to the "Guide to Mapping Units."

WINDBREAK GROUP 1

In this group are deep, moderately well drained to poorly drained, silty and loamy soils of the Badus, Davis, Egan, Graceville, Prosper, and Viborg series. These soils are on terraces and in swales on uplands.

Runoff is received from adjacent soils, but the brief periods of flooding are generally beneficial. Permeability is moderate to moderately slow. Available water capacity is moderate to high. Runoff is slow. Fertility is medium to high.

These soils have the most favorable available water capacity of all soils in the county for the planting of trees. Survival of plantings is excellent. Soils of this group are well suited to windbreaks planted for the protection of fields, farmsteads, and feedlots and for recreational and wildlife plantings.

WINDBREAK GROUP 2

In this group are deep, somewhat poorly drained and poorly drained, silty soils of the Lamo, Volga, and Whitewood series. These soils are on bottom lands and in swales and drainageways on uplands. Soils of the Volga are moderately deep over sand and gravel. These soils are moderately wet because of flooding, a fluctuating water table, or both. Permeability is moderately slow. Runoff is slow to very slow. Wetness is the main limitation to growing trees on soils of this group.

Soils of this group are well suited to windbreaks for the protection of fields, farmsteads, and feedlots. They also are suited to recreational and wildlife plantings. Suited trees and shrubs grow well because of the abundant supply of moisture. In places use of drainage practices improves growing conditions for trees.

WINDBREAK GROUP 3

In this group are deep, well-drained and excessively drained, loamy and silty soils of the Clarno, Egan, Ethan, Houdek, Moody, Nora, Prosper, Trent, Viborg, and Wentworth series. These soils are on uplands. Permeability is moderate to moderately slow, and runoff is slow to medium. Available water capacity is high. The fertility is medium or high. Susceptibility to water erosion depends on shape and gradient of slopes. Limitations for tree plantings generally are minor, except for periodic moisture shortages caused by the climate of the area.

Soils of this group are very well suited to windbreaks designed to protect fields, farmsteads, and feedlots and for recreational and wildlife plantings.

WINDBREAK GROUP 4

In this group are deep, well drained and moderately well drained, loamy to clayey soils that have a firm, dominantly clayey subsoil. It is made up of soils of the Beadle, Sinai, and Stickney series. These soils are on uplands. Permeability is moderately slow in the Beadle soils and slow in the Sinai and Stickney soils. Runoff is slow to medium, depending on the slope. Available water capacity is moderate to high, but the clayey subsoil releases moisture slowly to plants. Plant roots penetrate slowly in the clayey subsoil and underlying materials. In places tree growth is affected by the presence of salt in the underlying material.

Soils in this group are moderately suitable for field windbreaks. In areas where maximum height is not essential, they are also suitable for farmstead and feedlot windbreaks and for wildlife, recreational, and beautification plantings.

WINDBREAK GROUP 5

This group consists of deep, well-drained, loamy soils of the Henkin series. These soils are on uplands. They have a sandy loam subsoil and sandy loam and loamy sand underlying materials. Permeability is moderately rapid, and runoff is slow to medium. Available water capacity is low to moderate. These soils are susceptible to soil blowing if vegetation is absent. Sloping areas are susceptible to erosion. Fertility is low to medium. Practices that conserve moisture and control erosion are necessary to get tree plantings established.

These soils are well suited to field, farmstead, and feedlot windbreaks and to recreational and wildlife plantings. Use of a cover crop or a crop-residue mulch helps to control soil blowing during the first 3 years, when a stand of trees is getting established.

WINDBREAK GROUP 6

This group consists of well-drained and somewhat excessively drained, loamy and silty soils that are shallow to moderately deep over sand and gravel. In it are soils of the Delmont, Dempster, and Enet series. Permeability is moderate to moderately rapid in the upper part of the soil and rapid to very rapid in the underlying sand and gravel. Available water capacity is moderate in the Dempster soils and low in the Delmont and Enet soils. Fertility is low to medium. Susceptibility to drought is the main limitation for trees and shrubs.

TABLE 3.—*Woodland species by*

[Condition and height of trees and shrubs are based on measurements at 20 years of age, except those in italics, which are projected

Species	Windbreak group 1		Windbreak group 2	
	Condition	Height	Condition	Height
		Feet		*Feet*
American elm	Good	24–28	Good	22–26
Black Hills spruce	Good	24–30	Good	20–24
Boxelder	Fair	20–22	*Fair*	*18–20*
Buffaloberry	*Good*	*8–10*	*Fair*	*6–8*
Caragana	Good	9–11	Fair	7–9
Chinkota elm	Good	32–36	Good	24–28
Chokecherry	*Good*	*12–14*	*Fair*	*9–11*
Colorado blue spruce	Good	24–30	Good	20–24
Cotoneaster	Good	6–7	Fair	5–6
Cottonwood	Fair to good	35–40	Poor to good.	32–36
Crabapple	*Good*	*18–20*	*Good*	*16–18*
Dropmore elm	Good	24–28	Good	22–26
Eastern redcedar	Good	15–18	Good	14–16
Green ash	Good	23–27	Good	20–24
Golden willow	Good	32–35	Good	30–34
Hackberry	Good	23–27	Good	22–26
Harbin pear	*Good*	*16–18*	*Good*	*14–16*
Honeylocust	Good	30–34	Good	30–34
Honeysuckle	Good	8–10	Good	6–8
Lilac	Good	7–9	Good	5–6
Nanking cherry	*Good*	*5–7*	*Fair*	*4–5*
Plum	Good	8–9	Good	5–6
Ponderosa pine	Good	24–30	Good	20–22
Rocky Mountain juniper	Good	15–18	Good	14–16
Russian-olive	Fair	16–20	Fair	14–16
Siberian elm	Good	24–28	Good	22–26
White willow	Good	32–35	Good	30–34

These soils are moderately suited to windbreaks and to wildlife, recreational, and beautification plantings. Establishment of plantings depends on the use of moisture conservation practices. These include fallowing before planting, planting on the contour, use of cover crops to catch snow, and selecting drought-resistant trees and shrubs.

WINDBREAK GROUP 8

This group consists of the Crofton part of Nora-Crofton silt loams, 6 to 9 percent slopes. This is a deep, well-drained, calcareous, silty soil on uplands. Permeability is moderate, and runoff is medium. Available water capacity is high, but the high content of calcium carbonate affects the release of moisture to plants. Fertility and organic-matter content are low. These soils are susceptible to both soil blowing and erosion.

This soil is moderately suitable for windbreaks and for wildlife, recreational, and beautification plantings. Use of erosion control and moisture conservation practices helps to establish plantings.

WINDBREAK GROUP 10

In this group are soils of the Baltic, Betts, Clarno, Ethan, Talmo, Tetonka, and Worthing series and Sandy lake beaches. Soils in this group range widely in characteristics and qualities that affect their suitability for trees and shrubs. Some are too shallow over gravel, too stony, or too steep for the use of tree planting machinery. Others are too wet or too droughty for the survival of plantings.

These soils are not suited to windbreak plantings. Planting of species tolerant to the specific limitations is possible in places for wildlife and recreation. Such plantings are hand planted.

Use of the Soils for Wildlife[6]

In this section the soils of this county as they are suited to wildlife habitat are discussed in relation to the soil associations shown on the general soil map.

Lamo-Rauville association.—This association consists of somewhat poorly drained to very poorly drained soils on bottom lands along the East Fork of the Vermillion River. The river is shallow and is not deeply cut into the flood plain. These soils are farmed intensively. Native grasslands are mainly adjacent to the river. Significant areas of native woodlands are along riverbanks only in areas where livestock has been excluded.

[6] By JOHN B. FARLEY, biologist, Soil Conservation Service.

windbreak suitability groups

estimates. No height is given when the soils are rated poor for tree growth. Windbreak group 10 is unsuitable for trees]

Windbreak group 3		Windbreak group 4		Windbreak group 5		Windbreak group 6		Windbreak group 8	
Condition	Height	Condition	Height	Condition	Height	Condition	Height	Condition	Height
	Feet		*Feet*		*Feet*		*Feet*		*Feet*
Good	20–22	Fair	24–28	Fair	20–24	Fair to poor.	10–12	Fair	14–16
Good	24–28	Poor		Poor		Poor		Poor	
Fair	*20–22*	Poor		Poor		Poor		Poor	
Good	*7–9*	*Good*	*7–9*	*Fair*	*6–8*	*Fair*	*5–6*	*Fair*	*4–5*
Good	9–10	Fair	7–8	Good	8–10	Fair	6–7	Fair	7–8
Good	30–32	Good	36–40	Good	30–34	Fair	16–20	Fair	18–22
Good	*9–12*	*Good*	*10–12*	*Fair*	*9–11*	Poor		Poor	
Good	24–28	Poor		Poor		Poor		Poor	
Good	5–6	Good	6–7	Good	6–7	Fair	4–5	Fair	5–6
Poor		Poor		Poor		Poor		Poor	
Good	*15–17*	*Fair*	*13–15*	*Good*	*17–19*	*Fair*	*12–14*	Poor	
Good	20–22	Fair	24–28	Fair	20–24	Fair to poor.	10–12	Fair	14–16
Good	13–15	Good	15–17	Good	13–15	Fair	9–11	Fair	9–11
Good	20–24	Fair	21–26	Good	22–26	Fair	12–14	Fair	14–16
Poor		Poor		Poor		Poor		Poor	
Good	20–24	Fair	22–24	Good	21–25	Fair	10–12	Fair	14–16
Good	*15–17*	*Fair*	*13–15*	*Good*	*15–17*	*Fair*	*11–12*	*Fair*	*7–9*
Fair	26–30	Fair	24–26	Fair	28–32	Fair to poor.	15–17	Fair	17–20
Good	7–9	*Good*	*8–10*	Good	6–7	Fair	5–7	Fair	6–8
Good	6–7	*Fair*	*4–5*	Good	6–7	Fair	4–5	Fair	5–6
Fair	*5–6*	*Fair*	*4–5*	*Fair*	*4–5*	Poor		Poor	
Good	8–9	Good	8–9	Good	6–7	Poor		Poor	
Good	22–26	Good	17–23	Good	20–24	Fair	13–15	Fair	14–16
Good	13–15	Good	15–17	Good	13–15	Fair	9–11	Fair	9–11
Fair	15–18	Fair	16–22	Fair	14–18	Fair	9–12	Fair	14–16
Good	20–22	Fair	24–28	Fair	20–24	Fair to poor.	10–12	Fair	14–16
Poor		Poor		Poor		Poor		Poor	

Deer, primarily whitetail and some mule deer, are in this area. Furbearers, such as beaver, muskrat, and mink, are of minor importance. The river does not support a sport fishery.

These soils have a high natural potential for the development of wildlife habitat. Unless habitat is specifically developed, the current intensive farming of these soils does not provide a great amount of incidental habitat. Native grass pastures on the Rauville and Volga soils and in farmed areas of the Lamo soils provide abundant food for deer, partridge, quail, and mourning dove. Pheasant winter in the woody habitat along drainageways and stream channels.

Under present cropland use, field border plantings and use of single-row or multiple-row field windbreaks help to provide cover for wildlife. Conservative use of native grasslands for grazing also is helpful. Exclusion of livestock grazing in areas along the river stimulates spontaneous production of woody and herbaceous habitat.

Ducks and geese make rest and feeding stops, especially when seasons of migration coincide with high stream flows and the ponding of floodwaters. However, this area does not provide suitable habitat for waterfowl.

Dempster association.—This association has the most important recreational lakes in the county. These are Lake Madison, which has approximately 10 miles of shoreline, and Brant Lake, which is considerably smaller but deeper than Lake Madison.

The shoreline area of Lake Madison has been intensively developed for summer cottages and homesites. Water sports, swimming, power boating, and skiing are the primary recreational uses of Lake Madison. Both lakes provide fair to good fishing. The main sport fish are yellow perch, bullhead, bass, bluegill, walleyed pike, and northern pike. Rough fish, both carp and buffalo, are commercially seined at times from both lakes. These rough fish are consistently more abundant in Brant Lake than in Lake Madison.

Both lakes provide migratory habitat for large numbers of ducks and for some geese. Blue-winged teal, mallard, pintail, gadwall, and baldpate raise broods on these waters. Mink, beaver, and muskrat also occur, and the beaver population occasionally reaches the nuisance level. The nuisance aspect is associated with the felling of shoreline trees valued in landscaping.

Wildlife cover in scattered marsh areas and in farmstead windbreaks provides the main upland habitat in this area. Pheasant and mourning dove provide some hunting, but populations of bobwhite quail and Hungarian partridge are at considerably less than huntable levels.

Buffalo Slough, an area of public-owned wildlife land, is an excellent example of wildlife habitat development. Water levels are manipulated by a control structure in the outlet according to needs for encouraging duck production and for feeding use during migration periods. Upland areas of this project have been developed for pheasant habitat by excluding livestock and providing both prepared-site and scalp-planted tree belts.

Clarno-Ethan, Egan-Wentworth, and Wentworth-Sinai associations.—In these associations are scattered marshes that provide excellent habitat for deer and pheasants. Mourning dove population is high in the Egan-Wentworth association. Although farming use is intensive, there is enough undulating to rolling topography to provide odd areas that have incidental value for wildlife habitat.

The potential to develop the natural wetlands for increased waterfowl and furbearer production is high. The poorly drained Worthing soils in depressions provide different types of wildlife habitat at different times of the year. Many marshes are completely occupied by emergent aquatic vegetation. Without lessening their value for deer and other nonaquatic wildlife, these marshes could be provided with areas of open and more permanent water. Level ditching, excavated ponds, or blasted ponds are means of developing such areas.

An increase in needed conservation treatments on croplands would enhance the wildlife habitat in this area. This would include management needed to control erosion as well as the use of field border plantings and field windbreaks. Adding exterior shrub rows, underplanting with junipers, and excluding livestock help to increase the wildlife habitat value of all types of tree plantings. Conservative grazing use of pastures also benefits wildlife habitat.

There is an attractive State park and recreation area on the southern and eastern sides of Lake Herman. Native oak, cottonwood, and ash along the shoreline have been supplemented with plantings of conifers and flowering shrubs. There are a few summer cottages and homes on the shoreline. Because it is shallow, Lake Herman is marginal for maintaining a sport fishery.

Houdek-Prosper, Egan-Viborg, and Moody-Nora associations.—In these associations, farming is intensive and there are only minor amounts of wildlife habitat. Areas of wildlife habitat consist of odd areas on cultivated uplands, in windbreaks, and in closed depressions, which consist of Badus, Tetonka, and Worthing soils. There are also scattered marshes.

Many of the marshes are totally covered by emergent aquatic plants. They provide favorable cover for deer, pheasant, and other wildlife species. Considerable potential exists for development of these wetlands as habitat for waterfowl and furbearers. A potential also exists for plugging ditched outlets of depressions for the purpose of restoring wetland habitat sites.

Upland wildlife of greatest interest in this area are pheasant and deer.

Two large marsh areas in the Egan-Viborg association are under public ownership. They are managed for waterfowl, muskrat, and deer production and are open to the public for hunting and trapping. Milwaukee Lake is the larger and has the greatest amount of open water. The other marsh is Reynolds Slough.

Ethan-Clarno-Betts association.—This association has the least potential in the county for game and wildlife species. It consists of rolling, steep, upland breaks along the East Fork of the Vermillion River. Deer move up from the river and frequent the area. Much of the area is in native vegetation and is used for pasture. Intensive use as pasture prevents the improvement of habitat.

The highest potential in this area for developing wildlife habitat is for sport fisheries in the ponds constructed for livestock watering. These ponds can be stocked with warmwater species, such as bass, bluegill, and channel catfish. In places sites and water supplies are adequate for the development of trout ponds. These ponds also are favorable for waterfowl production and have some potential for muskrat and mink.

Engineering Uses of the Soils [7]

This section provides information of special interest to engineers, contractors, farmers, and others who use soil as structural material or as foundation material upon which structures are built. Discussed are properties of soil that affect construction and maintenance of roads, airports, pipelines, building foundations, facilities for water storage, erosion control structures, irrigation and drainage systems, sewage disposal systems, and other engineering works.

Among soil properties that are most important to the engineer are density, grain-size distribution, shear strength, shrink-swell potential, permeability, reaction, plasticity, and available water capacity. Such characteristics as the depth to the water table, depth to bedrock, and topography are also important.

Information concerning these and related soil properties is furnished in tables 4, 5, and 6. The estimates and interpretations of soil properties in these tables can be used to—

1. Plan detailed soil investigations of selected locations.
2. Make soil and land use studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
3. Plan and design agricultural drainage systems, water storage facilities, irrigation systems, erosion control practices, and other engineering works.
4. Select locations for highways, pipelines, utilities, and airports.
5. Locate probable sources of sand, gravel, and other construction materials.
6. Determine the suitability of routes for cross-country movement of vehicles and construction equipment.
7. Supplement the information obtained from other published maps, aerial photographs, and reports for the purpose of preparing reports that can readily be used by engineers.

This survey is not intended to eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and where excavations are

[7] JOHN P. TORGERSON, agricultural engineer, Soil Conservation Service, assisted in the preparation of this section.

deeper than the depths of layers here reported. Even in these situations, however, the soil map is useful in planning more detailed investigations and for indicating the kind of problems that may be expected.

Some terms used by soil scientists may be unfamiliar to engineers, and some words have different meanings in soil science than they have in engineering. For example, such terms as gravel, sand, silt, and clay as related to particle-size classification have a different range of sizes in soil science than in engineering. Agricultural scientists use the textural classification of the U.S. Department of Agriculture. In this system texture is determined by soil particles smaller than 2 millimeters in diameter and by percentages of sand, silt, and clay. Engineers have several classification systems, and the particle-size classification of gravel, sand, silt, and clay varies according to the system used. Persons using this section should become acquainted with the definition of these terms as it applies to the classification system used.

Some of the more common terms used in soil science are defined in the Glossary.

Engineering classification systems

The engineering systems now most widely used to classify soils are the Unified system (*8*) and the system adopted by the American Association of State Highway Officials (AASHO) (*1*).

The Unified Soil Classification System is based on the identification of soils according to particle-size distribution, plasticity, and liquid limit. In this system SW and SP are symbols for clean sands; SM for sand with nonplastic fines and SC for sand with plastic fines; GW and GP for clean gravel; GM and GC for gravel with nonplastic and plastic fines; ML and CL for nonplastic and plastic fine-grained materials of low liquid limit; and MH and CH for nonplastic and plastic fine-grained materials of high liquid limit. Soils in a narrow range on the borderline between two classes are designated by symbols for both classes, for example, ML–CL. Soils that have a wider range covering two or more classes are designated by two or more symbols, for example, ML or CL.

The AASHO classification system is based on those properties that affect highway construction and maintenance. In this system, a soil is placed in one of seven basic groups, A–1 through A–7. In group A–1 are gravelly soils of high bearing strength. At the other extreme in A–7 are clay soils that have low strength when wet. If a soil has a range, it is designated as being in both classes, for example, A–4 or A–6.

Estimated properties of the soils

Table 4 lists the soil series and mapping units in Lake County and gives estimates of some of the soil properties that affect engineering work. These estimates are based on test data shown in table 6, on test data on similar soils in other counties, and on knowledge of the soils gained during the course of the soil survey. A more complete description of each soil is in the section "Descriptions of the Soils." It should also be understood that many mapping units include minor soils that have properties other than those shown in table 4.

The column showing depth to bedrock was omitted because the soils in this county are deep enough over bedrock that bedrock generally does not affect their use. The column showing depth to the seasonal high water table was omitted because most of the soils in the county have a water table at a great enough depth that it does not generally affect their use.

The percentage of material passing the No. 10, 40, and 200 sieves reflects the normal range for a soil series. Most soils fall within the range given, but it should not be assumed that all of them do.

Permeability relates to the movement of water downward through an undisturbed soil. The estimates are based on soil structure and texture. Plowpans, surface crusts, and other properties resulting from the use of the soils are not considered.

Available water capacity is the capacity of a soil to hold water in a form available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Reaction is the degree of acidity or alkalinity of a soil, expressed as a pH value. The determinations were made by using a glass electrode or by color-indicator tests. Reaction is related to soil corrosivity and indicates the protection needed for structures such as pipelines when placed in the soil.

The shrink-swell potential is an indication of the volume change to be expected of the soil material with changes in moisture content. Shrinking and swelling of soils cause much damage to building foundations, roads, and other structures. A high shrink-swell potential indicates hazards to the maintenance of structures constructed in, on, or with such materials.

The depth to seasonal water table in all soils, except the Badus, Baltic, Lamo, Rauville, Volga, and Worthing, is greater than 5 feet and does not affect use and management. The Badus, Baltic, Lamo, Volga, and Worthing soils have a temporary or permanent water table between depths of 2 and 5 feet, and Rauville soils have a water table that is within a depth of 2 feet.

Interpretations of engineering properties

Table 5 gives the suitability of the soils for certain uses and shows specific characteristics that affect the design and construction of highways, sewage disposal systems, buildings, and farm facilities.

Ratings are given for the suitability of soil material for topsoil, for sand and gravel, and for road fill. Soils are rated as good, fair, poor, or not suitable as a source of topsoil according to their natural fertility and workability. Soils rated as sources of sand and gravel may require extensive exploration to find material that will be acceptable. Soils have been rated as good, fair, or poor sources of road fill materials based on the performance of the soil material if excavated and used as borrow for a highway subgrade.

The remaining columns in table 5 list soil features that affect engineering practices. Undesirable features are emphasized, but desirable features are also listed where applicable. Features shown for a given soil are based on the normal profile of that soil. Many mapping units include minor soils that have features other than those shown in table 5.

TABLE 4.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. Because that appear in the first column. The miscellaneous

Soil series and map symbols	Depth from surface	Classification		
		USDA texture	Unified	AASHO
	Inches			
Badus: Ba.	0–14	Silty clay loam	CL or CH	A–7
	14–34	Silty clay loam [1]	CL or CH	A–7
	34–60	Silty clay loam	CL or CH	A–7
Baltic: Bc.	0–11	Silty clay loam	ML–CL or CL	A–7
	11–35	Silty clay	CL or CH	A–6 or A–7
	35–60	Silty clay	CL	A–6 or A–7
Beadle: BdA, BdB, BdC.	0–60	Clay loam	CL	A–6 or A–7
Betts. Mapped only with soils of the Ethan series.	0–4	Loam	ML to CL	A–4 or A–6
	4–60	Clay loam	CL	A–6
*Clarno: CaA, CaB, CaC, CeB, CeC, CeD. For properties of Ethan soils in CeB, CeC, and CeD, see Ethan series in this table.	0–6	Loam	ML–CL or CL	A–6
	6–25	Clay loam	ML–CL or CL	A–6
	25–60	Clay loam	CL	A–6
Crofton. Mapped only with soils of the Nora series.	0–60	Silt loam	ML or CL	A–6
Davis: Da.	0–16	Loam	ML to CL	A–4 or A–6
	16–40	Loam and clay loam	ML to CL	A–4 or A–6
	40–60	Stratified silty clay loam to sandy loam.	ML, SM, or CL	A–4 to A–7
*Delmont: DeB, DeC. For properties of Talmo soils, see Talmo series in this table.	0–17	Loam	ML	A–4 or A–6
	17–60	Sand and gravel	SW–SM or SM	A–1 or A–2
*Dempster: DmA, DmB, DpC. For properties of Delmont soils in DpC, see Delmont series in this table.	0–10	Silt loam	ML to CL	A–4 or A–6
	10–36	Loam to silty clay loam	CL	A–6 or A–7
	36–60	Sand and gravel	SM or GM SW or GW	A–1 or A–2
*Egan: EaC, EbA, EbB, EbC, EeB, EeC2, EgA, EhB. For properties of Beadle soils in EbA, EbB, and EbC, Ethan soils in EeB and EeC2, Viborg soils in EgA, and Wentworth soils in EhB, see those series in this table.	0–31	Silty clay loam	ML–CL or CL	A–6 or A–7
	31–60	Clay loam	CL or CH	A–6 or A–7
Enet: EnA.	0–23	Loam	ML–CL or CL	A–4 or A–6
	23–60	Sand and gravel	SM or GM SW or GW	A–1 or A–2
*Ethan: EoF, ErE, EsE, EtD. For properties of Betts soils in EoF, Clarno soils in ErE and EsE, and Davis soils in EtD, see those series in this table.	0–7	Loam	ML–CL	A–4 or A–6
	7–60	Clay loam	CL	A–6
Graceville: Gr.	0–53	Silty clay loam	CL	A–6
	53–60	Sand or gravel	SM or GM SP or GP	A–1 to A–4
Henkin: HeA, HeB.	0–5	Loam	ML to CL	A–4 to A–6
	5–48	Sandy loam	SM	A–4 to A–2
	48–60	Loam to sand	SM or SC	A–2 to A–6

See footnotes at end of table.

significant in engineering

these soils may have different properties and limitations, it is necessary to follow carefully the instructions for referring to other series land type, Sandy lake beaches (Sa), is not listed]

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)				
			Inches per hour	*Inches per inch of soil*	*pH value*	
95–100	95–100	90–100	0. 20–0. 80	0. 14–0. 21	7. 4–8. 4	Moderate to high.
95–100	95–100	90–100	0. 20–0. 80	0. 14–0. 21	7. 4–7. 8	Moderate to high.
95–100	90–100	75–95	0. 20–0. 80	0. 14–0. 21	7. 4–8. 4	Moderate to high.
95–100	95–100	85–100	0. 20–0. 80	0. 14–0. 21	6. 6–8. 4	Moderate.
95–100	95–100	85–100	0. 05–0. 20	0. 13–0. 21	7. 9–8. 4	Moderate.
95–100	95–100	65–90	0. 20–0. 80	0. 14–0. 21	7. 9–8. 4	High.
95–100	90–100	70–85	0. 20–0. 80	0. 14–0. 21	6. 6–8. 4	Moderate to high.
95–100	85–95	60–85	1. 20–2. 00	0. 17–0. 19	7. 4–7. 8	Moderate.
95–100	85–95	60–80	0. 20–1. 20	0. 14–0. 21	7. 9–8. 4	Moderate.
95–100	90–100	60–80	1. 20–2. 00	0. 17–0. 19	6. 6–7. 3	Moderate.
95–100	90–100	70–80	0. 80–1. 20	0. 14–0. 21	6. 6–8. 4	Moderate.
95–100	90–100	60–80	0. 20–0. 80	0. 14–0. 21	7. 9–8. 4	Moderate.
95–100	90–100	70–100	0. 80–2. 00	0. 17–0. 19	7. 9–8. 4	Moderate.
95–100	90–100	70–85	1. 20–2. 00	0. 17–0. 19	6. 6–7. 3	Moderate.
95–100	90–100	70–85	0. 80–2. 00	0. 14–0. 21	6. 6–7. 3	Moderate.
95–100	60–100	36–80	0. 20–10. 00	0. 10–0. 21	7. 4–8. 4	Low to moderate.
90–100	65–85	50–75	2. 00–8. 00	0. 17–0. 19	6. 6–8. 4	Low.
45–70	10–40	5–20	8. 00–10. 00	0. 03–0. 06	7. 9–8. 4	Low.
80–100	60–100	60–95	0. 80–2. 00	0. 17–0. 19	6. 1–6. 5	Moderate.
80–100	60–100	60–95	0. 80–1. 20	0. 14–0. 21	6. 6–8. 4	Moderate.
45–100	15–65	0–20	8. 00–10. 00	0. 03–0. 06	7. 9–8. 4	Low.
95–100	95–100	90–100	0. 80–2. 00	0. 17–0. 21	6. 1–8. 4	Moderate.
90–95	80–95	65–80	0. 20–0. 80	0. 14–0. 21	7. 9–9. 0	High.
80–95	70–85	50–75	1. 20–2. 00	0. 17–0. 19	6. 6–7. 3	Low to moderate.
45–70	10–50	0–20	8. 00–10. 00	0. 03–0. 06	7. 9–8. 4	Low.
95–100	90–100	60–75	1. 20–2. 00	0. 17–0. 19	6. 6–7. 3	Low to moderate.
95–100	85–95	60–80	0. 20–1. 20	0. 14–0. 21	7. 4–9. 0	Moderate to high.
95–100	85–100	85–95	0. 80–1. 20	0. 14–0. 21	5. 6–6. 5	Moderate.
65–95	15–40	5–40	8. 00–10. 00	0. 03–0. 06	6. 1–6. 5	Low.
95–100	75–90	50–75	1. 20–2. 00	0. 17–0. 19	6. 1–6. 5	Low to moderate.
95–100	45–85	15–50	2. 00–5. 00	0. 10–0. 15	6. 1–8. 4	Low.
90–100	35–60	5–20	2. 00–10. 00	0. 03–0. 10	7. 9–8. 4	Low.

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TABLE 4.—*Estimated soil properties*

Soil series and map symbols	Depth from surface	Classification		
		USDA texture	Unified	AASHO
	Inches			
*Houdek: HkB, HpA. For properties of Prosper soils in HpA, see Prosper series in this table.	0–5	Loam	ML to CL	A–6
	5–29	Clay loam	CL	A–6
	29–60	Clay loam	CL	A–6
Lamo: La.	0–60	Silty clay loam	ML–CL or CL	A–6 or A–7
*Moody: MnB, MtA. For properties of Nora soils in MnB and Trent soils in MtA, see those series in this table.	0–10	Silty clay loam	ML–CL or CL	A–6 or A–7
	10–38	Silty clay loam and silt loam	ML–CL or CL	A–6 or A–7
	38–60	Silt loam	ML to CL	A–4 to A–6
*Nora: NcC. For properties of Crofton soils, see Crofton series in this table.	0–30	Silt loam	ML to CL	A–4 or A–6
	30–60	Silt loam	ML to CL	A–4 or A–6
Prosper: PrA.	0–19	Loam and clay loam	ML to CL	A–4 or A–6
	19–34	Clay loam	CL	A–6
	34–60	Clay loam	CL	A–6
Rauville: Ra.	0–23	Silty clay loam and silty clay	CL	A–6 or A–7
	23–60	Silty clay	CL	A–6 or A–7
Sinai: ScA, SdB.	0–7	Silty clay	CL or CH	A–7
	7–60	Silty clay	CL or CH	A–7
*Stickney: StA. For properties of Tetonka soils, see Tetonka series in this table.	0–19	Silty clay loam	ML to CL	A–6 or A–7
	19–36	Silty clay [2]	CL or CH	A–6 or A–7
	36–48	Silty clay loam	CL or CH	A–6 or A–7
	48–60	Clay loam	CL or CH	A–6 or A–7
*Talmo: TdE. For properties of Delmont soils, see Delmont series in this table.	0–7	Loam	ML	A–4 or A–6
	7–60	Sand and gravel	GM, GP, or GW	A–1 or A–2
Tetonka: Te.	0–22	Silt loam	CL	A–4 or A–6
	22–42	Silty clay	CL or CH	A–6 or A–7
	42–60	Silty clay loam	CL or CH	A–6 or A–7
Trent. Mapped only with soils of the Moody series.	0–38	Silty clay loam	ML–CL or CL	A–7
	38–60	Silt loam	ML to CL	A–4 or A–6
*Viborg: VbA, VgB. For properties of Egan soils in VgB, see Egan series in this table.	0–10	Silty clay loam	ML–CL or CL	A–7
	10–37	Silty clay loam	CL	A–7
	37–60	Clay loam	CL	A–6 or A–7
Volga: Vo.	0–28	Silty clay loam and sandy clay loam	CL	A–6 or A–7
	28–60	Loamy sand to gravel	SC or GC SM or GM	A–2 or A–4
*Wentworth: WeA. For properties of Egan soils, see Egan series in this table.	0–34	Silty clay loam	ML to CL	A–6 or A–7
	34–60	Silty clay loam	CL	A–6 or A–7
Whitewood: Wh.	0–60	Silty clay loam	ML–CL or CL	A–7 or A–6
Worthing: Wo.	0–10	Silty clay loam	ML–CL or CL	A–7
	10–48	Silty clay	CL or CH	A–7 or A–6
	48–60	Silty clay loam	CL	A–6

[1] Gypsum salts common at a depth of 14 to 34 inches in Badus soils.

significant in engineering—Continued

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)				
			Inches per hour	*Inches per inch of soil*	*pH value*	
95–100	85–100	60–80	1. 20–2. 00	0. 17–0. 19	6. 6–7. 3	Moderate.
95–100	85–100	70–85	0. 80–1. 20	0. 14–0. 21	6. 6–8. 4	Moderate.
95–100	85–100	60–80	0. 80–2. 00	0. 14–0. 21	7. 9–8. 4	Moderate.
90–100	75–100	50–95	0. 20–0. 80	0. 14–0. 21	7. 9–8. 4	Moderate.
95–100	90–100	80–100	0. 80–1. 20	0. 17–0. 21	6. 1–7. 3	Moderate.
95–100	90–100	70–100	0. 80–2. 00	0. 14–0. 19	6. 6–7. 3	Moderate.
95–100	90–100	70–100	0. 80–2. 00	0. 17–0. 19	7. 9–8. 4	Moderate.
95–100	95–100	70–100	0. 80–2. 00	0. 17–0. 19	6. 6–7. 8	Moderate.
95–100	85–100	50–90	0. 80–2. 00	0. 17–0. 19	7. 4–8. 4	Low to moderate.
95–100	85–100	60–80	1. 20–2. 00	0. 17–0. 19	6. 6–7. 3	Moderate.
95–100	85–100	60–80	0. 80–1. 20	0. 14–0. 21	6. 6–8. 4	Moderate.
95–100	85–100	60–80	0. 20–0. 80	0. 14–0. 21	8. 5–9. 0	Moderate.
95–100	85–100	75–100	0. 20–0. 80	0. 14–0. 21	7. 9–8. 4	Moderate to high.
95–100	85–100	75–100	0. 05–0. 20	0. 13–0. 21	7. 9–8. 4	Moderate to high.
95–100	95–100	90–100	0. 05–0. 80	0. 13–0. 21	6. 1–6. 5	Moderate to high.
95–100	95–100	90–100	0. 05–0. 20	0. 13–0. 21	6. 6–8. 4	Moderate to high.
95–100	95–100	80–95	0. 20–0. 80	0. 14–0. 21	6. 6–7. 3	Moderate.
95–100	95–100	80–95	0. 05–0. 20	0. 13–0. 21	6. 6–7. 8	Moderate to high.
95–100	95–100	80–95	0. 20–0. 80	0. 14–0. 21	7. 4–7. 8	Moderate to high.
95–100	95–100	60–85	0. 20–0. 80	0. 14–0. 21	7. 9–8. 4	Moderate to high.
85–95	75–90	60–75	1. 20–2. 50	0. 17–0. 19	6. 6–7. 3	Low.
60–90	30–80	0–35	10. 00–20. 00	0. 03–0. 06	7. 9–8. 4	Low.
95–100	90–100	70–90	0. 80–2. 00	0. 17–0. 19	6. 1–7. 3	Moderate.
95–100	90–100	75–95	0. 05–0. 20	0. 13–0. 21	7. 4–7. 8	Moderate to high.
95–100	85–95	65–95	0. 20–0. 80	0. 14–0. 21	7. 9–8. 4	Moderate to high.
95–100	95–100	90–100	0. 20–0. 80	0. 14–0. 21	6. 1–7. 3	Moderate.
95–100	95–100	70–100	0. 80–2. 00	0. 17–0. 19	6. 6–7. 8	Moderate.
95–100	95–100	90–100	0. 80–1. 20	0. 14–0. 21	6. 1–7. 3	Moderate.
95–100	90–100	65–90	0. 80–1. 20	0. 14–0. 21	6. 6–8. 4	Moderate.
95–100	85–95	65–85	0. 20–0. 80	0. 14–0. 21	7. 9–8. 4	Moderate.
90–100	75–100	50–95	0. 20–0. 80	0. 14–0. 21	7. 4–8. 4	Moderate.
60–90	30–60	15–40	10. 00–20. 00	0. 03–0. 10	7. 9–8. 4	Low to moderate.
95–100	95–100	90–100	0. 80–1. 20	0. 17–0. 21	6. 1–8. 4	Moderate.
90–95	80–95	75–95	0. 20–0. 80	0. 14–0. 21	7. 9 8. 4	Moderate.
95–100	90–100	65–95	0. 20–0. 80	0. 14–0. 21	6. 1–8. 4	Moderate.
95–100	95–100	90–100	0. 20–0. 80	0. 14–0. 21	6. 1–6. 5	Moderate.
95–100	95–100	90–100	0. 05–0. 20	0. 13–0. 21	6. 6–7. 8	Moderate to high.
95–100	90–100	75–95	0. 20–0. 80	0. 14–0. 21	7. 9–8. 4	Moderate.

[2] Moderate dispersion, slight salinity below a depth of 19 inches.

TABLE 5.—*Interpretations of engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. Because appear in the first column. The properties of

Soil series and map symbols	Suitability as a source of—			Soil limitations for sewage disposal		Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Septic tank filter fields	Sewage lagoons	Highway location
Badus: Ba	Fair in upper 14 inches: silty clay loam.	Not suitable: silty clay loam.	Poor: moderate to high shrink-swell potential; high compressibility; low to moderate shear strength; poor to fair compaction characteristics.	Severe: moderately slow permeability.	Severe: flooding.	Somewhat poorly drained to poorly drained; moderately susceptible to frost action.
Baltic: Bc	Fair in upper 11 inches: silty clay loam.	Not suitable: silty clay loam and silty clay.	Poor: high compressibility; moderate to high shrink-swell potential; generally wet.	Severe: slow permeability; moderately high water table.	Severe: flooding.	Poorly drained; moderately to highly susceptible to frost action.
Beadle: BdA, BdB, BdC	Good in upper 6 inches, fair at a depth of 6 to 14 inches: clay loam.	Not suitable: clay loam.	Poor: high compressibility; low shear strength; moderate to high shrink-swell potential.	Severe: moderately slow permeability.	Slight where slopes are 0 to 2 percent; moderate where slopes are 2 to 6 percent; severe where slopes are more than 6 percent.	Well drained; nearly level to undulating; erodible on slopes.
Betts Mapped only with the Ethan series.	Poor: thin surface layer; high in content of lime.	Not suitable: loam and clay loam.	Fair to poor: moderate shear strength and shrink-swell potential; high compressibility.	Severe: steep slopes.	Severe: steep	Steep; excessively drained; erodible; boulders on surface in some areas.
*Clarno: CaA, CaB, CaC, CeB, CeC, CeD. For interpretations of Ethan soils in CeB, CeC, and CeD, see Ethan series in this table.	Good in upper 6 inches; fair at a depth of 6 to 15 inches.	Not suitable: loam and clay loam.	Fair to poor: moderate shear strength and shrink-swell potential; medium to high compressibility.	Severe: moderately slow permeability in substratum.	Slight where slopes are 0 to 2 percent; moderate where slopes are 2 to 6 percent; severe where slopes are more than 6 percent.	Well drained; nearly level to hilly.

See footnote at end of table.

properties of soils

these soils may have different properties and limitations, it is necessary to follow carefully the instructions for referring to other series that Sandy lake beaches (Sa) are too variable to be estimated]

Soil features affecting—Continued						
Foundations for low buildings	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir areas	Embankments				
Poor bearing capacity; moderate to high shrink-swell potential; poorly drained.	Moderately slow permeability; good resistance to seepage and piping; poor foundation for large structures.	Moderate to high shrink-swell potential; fair stability; very slow permeability when compacted; poor to fair compaction characteristics.	Poorly drained; subject to flooding; moderately slow permeability.	Poorly drained; subject to salt accumulation.	Terraces not required.	Moderate to high available water capacity; poorly drained.
Poor bearing capacity; moderate to high shrink-swell potential; moderately high water table; poorly drained.	Slow permeability; good resistance to seepage and piping; poor foundation for large structures; moderately high water table.	Very slow permeability when compacted; poor to fair compaction characteristics.	Poorly drained; subject to flooding; moderately high water table; some areas lower than available outlets.	Poorly drained; subject to flooding; subject to salt accumulation.	Terraces generally not required.	Moderate to high available water capacity; moderately high water table.
Fair bearing capacity; moderate to high shrink-swell potential.	Moderately slow permeability; good resistance to piping.	Fair stability; fair compaction; good resistance to piping; slow permeability when compacted.	Well drained-----	Slow intake rate; moderate to high available water capacity; nearly level to undulating.	Nearly level to undulating; erodible on slopes; moderately slow permeability.	Nearly level to undulating; moderate to high available water capacity; well drained.
Fair bearing capacity; moderate shrink-swell potential.	Soil does not occur where reservoirs are normally constructed.	Fair to good stability; slow permeability when compacted; good resistance to piping.	Excessively drained.	Steep slopes; thin soil; low fertility.	Steep, short slopes; thin soil; boulders on surface in some areas; moderate permeability.	Thin soil; erodible; low fertility.
Fair bearing capacity; moderate shrink-swell potential.	Moderately slow permeability in substratum; good resistance to piping.	Fair to good stability; slow permeability when compacted.	Well drained-----	Well drained; moderate intake rate; high available water capacity; slow internal drainage in substratum.	Plane to convex slopes; nearly level to hilly; moderate permeability.	Medium fertility; nearly level to hilly.

TABLE 5.—*Interpretations of engineering*

Soil series and map symbols	Suitability as a source of—			Soil limitations for sewage disposal		Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Septic tank filter fields	Sewage lagoons	Highway location
Crofton Mapped only with soils of the Nora series.	Poor: thin surface layer; high in content of lime.	Not suitable: silt loam.	Fair to poor: medium to high compressibility; moderate shrink-swell potential; low to moderate shear strength.	Moderate: moderate permeability; 6 to 9 percent slopes.	Severe: slopes of more than 6 percent.	Well drained; sloping; high-highly erodible.
Davis: Da	Good in upper 9 inches; fair at a depth of 9 to 16 inches.	Not suitable: loam and clay loam.	Fair to poor: moderate shrink-swell potential; low to moderate shear strength; medium to high compressibility.	Severe: occasionally flooded.	Severe: occasionally flooded.	Nearly level to gently sloping; moderately well drained.
*Delmont: DeB, DeC For interpretations of Talmo soils, see Talmo series in this table.	Good in upper 6 inches; fair at a depth of 6 to 14 inches.	Good below a depth of 17 inches.	Good: high shear strength; good compaction characteristics; low shrink-swell potential.	Slight:[1] rapid permeability in substratum.	Severe: rapid permeability in substratum	Somewhat excessively drained; good bearing strength; erodible.
*Dempster: DmA, DmB, DpC For interpretations of Delmont soils in DpC, see Delmont series in this table.	Good in upper 10 inches; fair at a depth of 10 to 18 inches.	Good below a depth of 36 inches.	Fair to poor above a depth of 36 inches; good below a depth of 36 inches.	Slight:[1] rapid permeability in substratum.	Severe: rapid permeability in substratum.	Well drained; nearly level to gently sloping; good bearing capacity.
*Egan: EaC, EbA, EbB, EbC, EeB, EeC2, EgA, EhB. For interpretations of Beadle soil in EbA, EbB, and EbC, Ethan soils in EeB and EeC2, Viborg soils in EgA, and for Wentworth soils in EhB, see those series in this table.	Good in upper 15 inches; fair at a depth of 15 to 24 inches.	Not suitable: silty clay loam.	Poor: high compressibility; moderate to high shrink-swell potential; low to moderate shear strength.	Severe: moderately slow permeability in substratum.	Moderate: where slopes are less than 6 percent, severe where slopes are more than 6 percent; moderate permeability in upper part of profile.	Well drained; nearly level to sloping.

See footnote at end of table.

properties of soils—Continued

Soil features affecting—Continued						
Foundations for low buildings	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir areas	Embankments				
Poor to fair bearing capacity; moderate shrink-swell potential; well drained.	Moderate permeability; subject to seepage and piping in places.	Moderate to slow permeability when compacted; fair stability.	Well drained-----	Well drained; sloping; thin surface layer; low fertility; highly erodible.	Thin surface layer; highly erodible; sloping.	Erodible; thin surface layer; low fertility.
Fair to poor bearing capacity; moderate shrink-swell potential; moderately well drained.	Moderate permeability; pervious substratum in places.	Fair stability; slow to moderate permeability when compacted.	Moderately well drained; nearly level to gently sloping; subject to occasional flooding.	Moderately well drained; nearly level to gently sloping; subject to occasional flooding; moderate to high available water capacity.	Moderate permeability; nearly level to gently sloping.	Moderately well drained; subject to occasional flooding; high fertility.
Good bearing capacity; somewhat excessively drained; low shrink-swell potential.	Rapid permeability in substratum; excessive seepage without control.	Rapid permeability in substratum; suitable if mixed with finer textured material.	Somewhat excessively drained.	Somewhat excessively drained; shallow over gravel; low available water capacity; low fertility; erodible.	Sandy substratum limits channel cuts; low fertility and low available water capacity; moderately rapid permeability; erodible.	Highly erodible in cuts; droughty; low fertility.
Good bearing capacity; well drained; low shrink-swell potential below a depth of 36 inches.	Rapid permeability in substratum; excessive seepage without control.	Rapid permeability in substratum; good suitability for zone fills.	Well drained-----	Well drained; nearly level to sloping; moderate available water capacity; moderate intake rate.	Erodible on steeper slopes; moderate permeability; moderately deep over sand and gravel.	Erodible on steeper slopes; moderate available water capacity: sand and gravel below a depth of 36 inches.
Fair bearing capacity; moderate to high shrink-swell potential.	Moderately slow permeability in substratum; fair to poor foundation material; good resistance to piping.	Slow permeability when compacted; fair stability; fair compaction.	Well drained-----	Nearly level to sloping; high available water capacity; slow internal drainage in substratum.	Erodible on slopes; moderate permeability.	Medium to high fertility; high available water capacity.

TABLE 5.—*Interpretations of engineering*

Soil series and map symbols	Suitability as a source of—			Soil limitations for sewage disposal		Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Septic tank filter fields	Sewage lagoons	Highway location
Enet: EnA	Good in upper 7 inches; fair at a depth of 6 to 23 inches.	Good below a depth of 23 inches.	Good: high shear strength; good compaction characteristics; low shrink-swell potential below a depth of 23 inches.	Slight: [1] rapid permeability in substratum.	Severe: rapid permeability in substratum.	Well drained; good bearing strength; erodible
*Ethan: EoF, ErE, EsE, EtD— For interpretations of Betts soils in EoF, Clarno soils in ErE and EsE, and Davis soils in EtD, see those series in this table.	Good in upper 7 inches; fair at a depth of 7 to 12 inches.	Not suitable: loam and clay loam.	Poor: medium to high compressibility; moderate shear strength; moderate to high shrink-swell potential; fair to good compaction characteristics.	Severe: gently undulating to steep; moderate to moderately slow permeability.	Moderate where slopes are less than 6 percent, severe where slopes are more than 6 percent: moderate permeability in upper part of profile.	Gently undulating to steep; erodible.
Graceville: Gr	Good in upper 10 inches; fair at a depth of 10 to 16 inches.	Some areas may be suitable at a depth of more than 40 inches.	Poor above a depth of 53 inches; fair to good below a depth of 53 inches.	Moderate to severe: [1] subject to flooding in some areas.	Severe: rapid permeability in substratum.	Moderately well drained; nearly level; subject to flooding.
Henkin: HeA, HeB	Fair in upper 5 inches.	Some areas may be suitable for sand with large amount of fines.	Good: low shrink-swell potential; slight compressibility; moderate to high shear strength.	Slight: [1] moderately rapid permeability.	Severe: moderately rapid permeability.	Well drained; nearly level to sloping; erodible.
*Houdek: HkB, HpA— For interpretations of Prosper soils in HpA, see Prosper series in this table.	Good in upper 5 inches; fair at a depth of 5 to 16 inches.	Not suitable.	Poor to fair: moderate shear strength and shrink-swell potential; medium to high compressibility.	Severe: moderately slow permeability in substratum.	Slight where slopes are less than 2 percent; moderate where slopes are 2 to 6 percent; severe where slopes are more than 6 percent.	Well drained; nearly level to gently undulating.

See footnote at end of table.

properties of soils—Continued

Soil features affecting—Continued						
Foundations for low buildings	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir areas	Embankments				
Good bearing capacity; well drained; low shrink-swell potential below a depth of 23 inches.	Moderately rapid permeability; excessive seepage without control.	Moderately rapid permeability; suitable only in zone fills or if mixed with finer textured material.	Well drained	Well drained; low available water capacity.	Sand and gravel substratum limits channel cuts; low fertility and available water capacity; moderately rapid permeability.	Sand and gravel substratum limits cuts; droughty.
Fair bearing capacity; moderate to high shrink-swell potential.	Moderate to moderately slow permeability in substratum; good resistance to piping.	Fair to good stability; slow permeability when compacted; good resistance to piping; fair to good compaction characteristics.	Well drained	Gently undulating to steep; moderate intake rate; high available water capacity; erodible; slow internal drainage in substratum.	Short, irregular slopes; low fertility; moderate to moderately slow permeability; stony in places.	Low fertility.
Good bearing capacity below a depth of 53 inches; moderately well drained.	Rapid permeability in substratum; subject to seepage and piping.	Fair to good stability; may require zone fill; sand and gravel substratum; material highly pervious.	Moderately well drained; subject to flooding; moderate permeability.	Moderate to high available water capacity; moderately well drained; subject to flooding.	Terraces generally not required.	Moderate to high available water capacity; high fertility.
Good bearing capacity; well drained; low shrink-swell potential.	Moderately rapid permeability; subject to seepage and piping.	Fair to good compaction and stability; may require zone fill to control seepage and piping.	Well drained	Nearly level to sloping; moderate to low available water capacity; high intake rate.	Nearly level to sloping; moderately rapid permeability; erodible.	Moderate to low available water capacity; erodible; low to medium fertility.
Fair bearing capacity; moderate shrink-swell potential.	Moderate permeability; good resistance to piping.	Slow permeability when compacted; fair to good stability; good resistance to piping.	Well drained	Nearly level to gently undulating; high available water capacity; slow internal drainage in substratum.	Nearly level to gently undulating; moderate permeability.	Medium fertility; nearly level to gently undulating.

TABLE 5.—*Interpretations of engineering*

Soil series and map symbols	Suitability as a source of—			Soil limitations for sewage disposal		Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Septic tank filter fields	Sewage lagoons	Highway location
Lamo: La	Good in upper 9 inches; fair at a depth of 9 to 17 inches.	Not suitable.	Poor to fair: low to moderate shear strength; moderate shrink-swell potential; medium to high compressibility.	Severe: high water table; moderately slow permeability.	Severe: subject to flooding.	Somewhat poorly drained; nearly level; subject to flooding; high water table highly susceptible to frost action.
*Moody: MnB, MtA. For interpretations of Nora soils in MnB and Trent soils in MtA, see those series in this table.	Good in upper 10 inches; fair at a depth of 10 to 18 inches.	Not suitable.	Poor to fair: low to moderate shear strength; moderate shrink-swell potential; medium compressibility.	Moderate: moderate permeability.	Moderate: moderate permeability.	Well drained; nearly level to gently sloping.
*Nora: NcC. For interpretations of Crofton soils, see Crofton series in this table.	Good in upper 7 inches.	Not suitable.	Poor to fair: low to moderate shear strength; medium compressibility.	Moderate: moderate permeability.	Moderate where slopes are 2 to 6 percent, severe where slopes are more than 6 percent; moderate permeability.	Well drained; gently sloping to sloping; erodible.
Prosper: PrA	Good in upper 6 inches; fair at a depth of 6 to 12 inches.	Not suitable.	Poor: low to moderate shear strength; moderate shrink-swell potential; medium to high compressibility.	Severe: subject to flooding; moderately slow permeability in substratum.	Severe: subject to flooding.	Nearly level; subject to flooding; moderately well drained; moderately susceptible to frost action.
Rauville: Ra	Poor: clayey and wet.	Not suitable.	Poor: high water table; moderate to high shrink-swell potential; medium to high compressibility.	Severe: high water table; frequently flooded.	Severe: high water table; frequently flooded.	Poorly drained to very poorly drained; high water table; frequently flooded; moderate to high susceptibility to frost action.

See footnote at end of table.

properties of soils—Continued

Soil features affecting—Continued						
Foundations for low buildings	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir areas	Embankments				
Fair to poor bearing capacity; moderate shrink-swell potential; subject to flooding; high water table; highly susceptible to frost action.	High water table; moderately slow permeability.	Moderately slow permeability; fair stability; poor to fair resistance to piping.	Somewhat poorly drained; nearly level; high water table; moderately slow permeability.	Nearly level; high water table; subject to flooding; slow internal drainage.	Nearly level; moderately slow permeability; high water table.	High fertility; nearly level; subject to flooding; high water table.
Poor to fair bearing capacity; moderate shrink-swell potential.	Moderate permeability; subject to seepage and piping in places; poor foundation for large structures.	Slow to moderate permeability when compacted; fair stability; erodible.	Well drained	Well drained; nearly level to gently sloping; erodible on slopes; high available water capacity.	Nearly level to gently sloping; long slopes; erodible; moderate permeability.	High fertility; erodible; high available water capacity.
Poor to fair bearing capacity; well drained.	Moderate permeability; subject to seepage and piping in places; poor foundation for large structures.	Slow to moderate permeability when compacted; fair stability; erodible.	Well drained	Well drained; gently sloping to sloping; erodible; high available water capacity.	Gently sloping to sloping; long slopes; erodible; moderate permeability.	Medium fertility; high available water capacity; erodible.
Fair bearing capacity; moderate shrink-swell potential; subject to flooding.	Moderately slow permeability in substratum; good resistance to piping.	Slow permeability when compacted; fair stability; good resistance to piping.	Nearly level; moderately well drained; slow internal drainage in substratum.	Nearly level; subject to flooding; high available water capacity; slow internal drainage in substratum.	Nearly level; moderate to moderately slow permeability.	High fertility; nearly level.
Moderate to high shrink-swell potential; high water table; medium to high compressibility; frequently flooded.	Slow permeability; high water table; poor foundation for large structures.	High water table; frequently flooded; high organic-matter content.	Poorly drained to very poorly drained; frequently flooded; high water table; drainage outlets lacking.	Poorly drained to very poorly drained; frequently flooded; high water table.	Level; high water table; slow permeability.	Poorly drained to very poorly drained; outlets lacking.

TABLE 5.—*Interpretations of engineering*

Soil series and map symbols	Suitability as a source of—			Soil limitations for sewage disposal		Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Septic tank filter fields	Sewage lagoons	Highway location
Sinai: ScA, SdB	Fair in upper 7 inches.	Not suitable.	Poor: moderate to high shrink-swell potential; high compressibility; low to moderate shear strength; poor workability.	Severe: slow permeability.	Slight	Well drained; nearly level to gently sloping.
*Stickney: StA For interpretations of Tetonka soils, see Tetonka series in this table.	Good in upper 12 inches; poor below a depth of 12 inches.	Not suitable.	Poor: low to moderate shear strength; moderate to high shrink-swell potential; medium to high compressibility.	Severe: slow permeability.	Slight	Moderately well drained; nearly level.
*Talmo: TdE For interpretations of Delmont soils, see Delmont series in this table.	Not suitable: shallow surface layer.	Good for gravel below a depth of 7 inches.	Good: low shrink-swell potential; high shear strength; low compressibility; good compaction characteristics.	Slight:[1] rapid permeability; gently undulating to hilly.	Severe: rapid permeability.	Excessively drained; gently undulating to hilly; erodible.
Tetonka: Te	Good in upper 9 inches; poor below a depth of 9 inches.	Not suitable.	Poor: poor to fair shear strength; moderate to high shrink-swell potential; high to very high compressibility.	Severe: slow permeability.	Severe: frequent flooding.	Somewhat poorly drained; subject to flooding; moderately susceptible to frost action.
Trent Mapped only with soils of the Moody series.	Good in upper 12 inches; fair at a depth of 12 to 20 inches.	Not suitable.	Poor to fair: low to moderate shear strength; moderate shrink-swell potential; medium compressibility.	Severe: occasionally flooded.	Moderate	Moderately well drained; nearly level; subject to occasional flooding; moderately susceptible to frost action.

See footnote at end of table.

properties of soils—Continued

Soil features affecting—Continued						
Foundations for low buildings	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir areas	Embankments				
Fair bearing capacity; moderate to high shrink-swell potential; high compressibility.	Slow permeability; good resistance to seepage and piping; high compressibility.	Slow permeability; good resistance to seepage and piping; fair stability; poor workability.	Well drained-----	Well drained; nearly level to gently sloping; slow intake rate; high available water capacity.	Nearly level to gently sloping; slow permeability.	Medium fertility; well drained; erodible.
Fair bearing capacity; moderate to high shrink-swell potential; high compressibility.	Slow permeability; good resistance to seepage and piping; poor foundation for large structures.	Fair stability; impervious when compacted; fair compaction characteristics; high compressibility.	Moderately well drained.	Nearly level; slow intake rate; subject to salt accumulation.	Nearly level; slow permeability.	Medium fertility; moderately well drained; slow permeability.
Good bearing capacity; excessively drained; low shrink-swell potential.	Rapid permeability; excessive seepage without control.	Fair to good stability; requires zone fill or mixing with finer grained material to control seepage in places.	Excessively drained.	Excessively drained; high intake rate; low available water capacity.	Shallow over gravel; undulating to hilly; rapid permeability.	Shallow over gravel; erodible in cuts; low available water capacity.
Poor bearing capacity; subject to flooding; poorly drained; moderate to high shrink-swell potential.	Slow permeability; poor foundation for large structures.	Impervious when compacted; fair stability; generally wet; high organic-matter content; high compressibility.	Poorly drained; subject to flooding; slow permeability; outlets not available in places.	Poorly drained; frequently flooded; slow intake rate; subject to salt accumulation.	Surface runoff is ponded; slow permeability; terraces not needed.	Ponded runoff; slow internal drainage; subject to frequent flooding and sedimentation.
Poor to fair bearing capacity; moderate shrink-swell potential; subject to occasional flooding.	Moderately slow permeability; subject to seepage and piping in places; poor foundation for large structures.	Moderate to slow permeability when compacted; subject to seepage and piping in places; medium compressibility.	Moderately well drained; subject to occasional flooding; moderately slow permeability.	Moderately well drained; nearly level; subject to occasional flooding; high available water capacity.	Nearly level; slow surface runoff; moderately slow permeability.	High fertility; slow surface runoff; subject to occasional flooding.

TABLE 5.—*Interpretations of engineering*

Soil series and map symbols	Suitability as a source of—			Soil limitations for sewage disposal		Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Septic tank filter fields	Sewage lagoons	Highway location
*Viborg: VbA, VgB---- For interpretations of Egan soils in VgB, see Egan series in this table.	Good in upper 10 inches; fair at a depth of 10 to 16 inches.	Not suitable.	Fair to poor: low to moderate shear strength; moderate shrink-swell potential; medium compressibility.	Severe: moderately slow permeability in substratum.	Moderate to severe: subject to flooding in some areas.	Moderately well drained; nearly level to gently sloping; subject to flooding; moderate to high susceptibility to frost action.
Volga: Vo----	Good in upper 9 inches; fair at a depth of 9 to 17 inches.	Fair: excessive fines; water table may hinder excavation.	Poor: water table limits excavation; good fill material below a depth of 28 inches where practical to excavate.	Severe: high water table.	Severe: high water table.	Somewhat poorly drained to poorly drained; high water table; moderately susceptible to frost action.
*Wentworth: WeA---- For interpretations of Egan soils, see Egan series in this table.	Good in upper 7 inches; fair at a depth of 7 to 15 inches.	Not suitable.	Fair to poor: low to moderate shear strength; moderate shrink-swell potential; medium compressibility.	Severe: moderately slow permeability in substratum.	Moderate: nearly level to gently sloping; moderate permeability.	Well drained; nearly level to gently sloping; erodible on slopes.
Whitewood: Wh----	Good in upper 7 inches; fair at a depth of 7 to 16 inches.	Not suitable.	Poor: low to moderate shear strength; moderate shrink-swell potential; medium compressibility; generally wet.	Severe: moderately slow permeability.	Severe: subject to flooding.	Somewhat poorly drained; occasionally flooded; moderate to high susceptibility to frost action.
Worthing: Wo----	Fair in upper 10 inches.	Not suitable.	Poor: low shear strength; medium to high compressibility; moderate to high shrink-swell potential; generally wet.	Severe: slow permeability; subject to flooding; moderately high water table.	Moderate----	Poorly drained; subject to flooding; moderately high water table.

[1] Possible contamination of ground water supplies.

properties of soils—Continued

Soil features affecting—Continued						
Foundations for low buildings	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir areas	Embankments				
Poor to fair bearing capacity; moderate shrink-swell potential; subject to flooding.	Moderately slow permeability in substratum; fair to good resistance to piping; fair to poor foundation material.	Slow permeability when compacted; fair to good compaction characteristics; fair stability.	Moderately well drained; subject to flooding moderate permeability.	Moderately well drained; nearly level to gently sloping; slow internal drainage in substratum; high available water capacity.	Nearly level to gently sloping; moderate permeability.	High fertility; subject to flooding; slow surface runoff.
High water table; frequently flooded.	Rapid permeability in substratum; subject to excessive seepage without control; high water table.	High water table limits excavation; good fill material below a depth of 28 inches where practical to excavate.	Somewhat poorly drained to poorly drained; high water table; frequently flooded.	Somewhat poorly drained to poorly drained; high water table; frequently flooded.	Nearly level; high water table.	High water table; frequently flooded; sand and gravel at a depth of 28 inches.
Poor to fair bearing capacity; moderate shrink-swell potential; medium compressibility.	Moderate permeability; may be subject to seepage and piping; poor to fair foundation for large structures.	Slow permeability when compacted; may be subject to seepage and piping; fair stability.	Well drained-----	Well drained; nearly level to sloping; high available water capacity.	Nearly level to sloping; moderate permeability; erodible on slopes.	Medium to high fertility; medium runoff; erodible; high available water capacity.
Medium to high compressibility somewhat poorly drained; occasionally flooded.	Moderately slow permeability; medium compressibility; poor foundation for large structures.	Generally high water content; slow permeability when compacted; fair stability.	Somewhat poorly drained; occasionally flooded; moderately slow permeability.	Somewhat poorly drained; occasionally flooded; slow internal drainage in substratum.	Somewhat poorly drained; slow runoff; terraces not needed.	Somewhat poorly drained; occasionally flooded; moderate to high available water capacity.
Fair bearing capacity; subject to flooding; moderately high water table; moderate to high shrink-swell potential; poorly drained.	Slow permeability; moderately high water table; poor foundation for large structures.	Very slow permeability when compacted; generally high water content; moderately high water table; medium to high compressibility.	Poorly drained; subject to flooding; moderately high water table; slow permeability; outlets not available in places.	Poorly drained; subject to flooding; moderately high water table; slow internal drainage.	Poorly drained; surface runoff is ponded; terraces not needed.	Poorly drained; surface runoff is ponded; subject to flooding.

TABLE 6.—*Engineering*

[Tests performed by South Dakota Department of Highways in cooperation with the U.S. Department of Commerce, Bureau

Soil name and location	Parent material	Depth from surface	Moisture density data [1]	
			Maximum dry density	Optimum moisture
		Inches	*Lb. per cu. ft.*	*Percent*
Egan silty clay loam: 174 feet N. and 1,440 feet E. of SW. corner of sec. 27, T. 107 N., R. 52 W.	Silty drift over glacial till.	15–24 31–42	103 104	20 20
Ethan loam: 435 feet N. and 390 feet W. of S. quarter corner of sec. 3, T. 106 N., R. 54 W.	Glacial till.	12–28	111	16
Sinai silty clay: 141 feet S. and 345 feet E. of NW. corner of sec. 33, T. 108 N., R. 53 W.	Glacial material.	15–26 40–48	94 99	22 22
Sinai silty clay loam: 516 feet E. and 642 feet N. of W. quarter corner of sec. 34, T. 108 N., R. 54 W.	Glacial material.	12–21 38–49	100 102	21 21
Viborg silty clay loam: 345 feet W. and 700 feet N. of E. quarter corner of sec. 31, T. 108 N., R. 51 W.	Silty material over firm loam and clay loam glacial till of unknown age.	0–11 11–16 45–60	91 96 107	24 22 19
Worthing silty clay loam: 1,270 feet S. and 1,776 feet E. of NW. corner of sec. 4, T. 105 N., R. 53 W.	Alluvium.	30–43 54–60	101 110	22 16

[1] Based on AASHO Designation T 99–57, Method A (*1*).

[2] Mechanical analyses according to the AASHO Designation T 88–57 (*1*). Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method

Engineers and others should not apply specific values to the estimates of bearing capacity given under the column which shows limitations of soils for low buildings.

Engineering test data

Table 6 presents the data obtained by laboratory tests on samples from soil profiles. The tests were performed by the South Dakota Department of Highways in cooperation with the U.S. Bureau of Public Roads. Some of the terms used in table 6 are explained in the following paragraphs.

Maximum dry density is the maximum unit dry weight of the soil when it has been compacted at optimum moisture content by the prescribed method of compaction. The moisture content which gives the highest unit dry weight is called the *optimum moisture content* for the specific method of compaction.

In mechanical analysis, the soil particles are sorted by size. Sand and other granular material are retained on a No. 200 sieve, but finer particles pass through the openings. Clay particles are less than 0.002 millimeter in diameter. The material intermediate in size between that held on the No. 200 sieve and that having a diameter of 0.002 millimeter is mostly silt. The clay fraction was determined by the hydrometer method rather than by the pipette method used by most soil scientists in determining clay content in soil samples.

The tests for liquid limit measure the effect of water on the consistence of the soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the material passes from a semisolid to a plastic state. The liquid limit is the moisture content at which the material passes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic.

Formation and Classification of the Soils

This section consists of three parts. The first part relates the five factors of soil formation to the soils in Lake County. The second part tells of some of the processes at work in forming soil horizons. The third part describes the system of classifying soils and shows the

test data

of Public Roads, in accordance with standard procedures of the American Association of State Highway Officials (AASHO)]

Mechanical analysis [2]					Liquid limit	Plasticity index	Classification	
Percentage passing sieve—				Percentage smaller than (0. 005mm.)			AASHO [3]	Unified [4]
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)					
					Percent			
		100	99	36	43	21	A–7–6(13)	CL
96	94	87	73	47	52	31	A–7–6(18)	CH
76	74	66	51	27	38	20	A–6(7)	CL
100	100	100	98	63	57	31	A–7–6(19)	CH
100	100	99	97	68	56	32	A–7–6(19)	CH
100	100	100	94	44	50	23	A–7–6(15)	ML–CL
100	100	100	97	42	43	23	A–7–6(14)	CL
100	100	99	97	35	47	20	A–7–6(13)	ML–CL
100	100	99	97	35	47	22	A–7–6(14)	CL
99	98	92	74	42	46	27	A–7–6(16)	CL
100	100	100	99	48	51	72	A–7–6(17)	CH
100	100	97	88	26	37	18	A–6(11)	CL

and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soil.

[3] Based on AASHO Designation M 145–49 (*1*).

[4] Based on the Unified soil classification system (*8*). SCS and BPR have agreed to consider that all soils having plasticity indexes within two points of A-line are to be given a borderline classification. An example is ML–CL.

placement of the soils of this county in the classification system.

Formation of the Soils

The characteristics of the soils at any given point are determined by the interaction of the five major factors of soil formation. These factors are climate, plant and animal life, parent material, topography, and time.

Climate

The climate of Lake County is characteristic of a continental climate that is marked by extreme seasonal temperature changes. It has an annual precipitation of about 23 inches and an average air temperature of 46° F. An average of about 18 inches of precipitation occurs during the normal growing season. The cool temperature has promoted the accumulation of organic matter and dark colors in the surface layer of the soils. With this type of climate, lime accumulates at a moderate depth in most soils. Additional climatic data are given in the section "General Nature of the County."

Plant and animal life

Plants, animals, insects, earthworms, bacteria, and fungi are important in soil formation. The kinds and amount of vegetation determine the organic-matter content, the color of the surface layer, and the amount of nutrients in the soil. Earthworms, cicada, and burrowing animals help keep the soil open and porous. Bacteria and fungi decompose the vegetation, thus releasing nutrients for plant food.

Mid and tall, mixed prairie grasses have had more influence on soil formation in Lake County than any other living organism. The result has been soils that have a moderate to high amount of organic matter in the surface layer, and soil reaction that generally is favorable to plant growth without requiring soil amendments, such as lime.

Parent material [8]

Parent material is the unconsolidated mass from which soils are formed. It influences the mineralogical and chemical composition of the soil and, to some extent, the rate at which the soil-forming processes take place. The main parent material in Lake County is glacial till of Late Wisconsin age.

In Lake County, soils formed in glacial materials, stream deposits, and loess. Lake County is located on the southern end of the Coteau du Prairie (*3*).

[8] By JAMES R. MONAGHAN, geologist, Soil Conservation Service.

The Coteau du Prairie was developed under the stagnant-ice conditions of Middle Wisconsin age. The features of the stagnant ice are present, but they are generally more subdued than in the northern end of the Coteau du Prairie. Ice-wall lakes (*2*) with the associated collapse features are fairly common and are easily seen on aerial photographs. Disintegration ridges are less common.

The typical arrangement of the ice-wall lake sediments in relation to the other dead-ice moraine features is as follows: In the center are fine-grained, lake-deposited sediments. They generally are fairly smooth on the surface, but there are some distorted, collapsed lake sediments on the outer margins. Sinai and Wentworth are predominant soils that developed on the lakebed. Around the outside of the lake sediments are till, sand, and gravel deposits that display collapse and slumping distortion caused as the ice walls of the lake melted.

Typical soils in the areas of collapse till are those of the Egan series. These areas in places form a moatlike topography around part or all of the areas of lake sediments. The dead-ice moraine surrounds the lake area. The moraine-till soils are typically of the Viborg and Whitewood series.

Till of Middle Wisconsin age is present over most of the county. The till is mainly clayey silt material that contains a limited amount of pebbles and sand. The ground moraine area has a low, slightly undulating relief and some undrained depressions. Soils developed in ground-moraine areas are generally deep, silty, and well drained to poorly drained. They range from young soils in the drainageways and depressions to the older, mature soils on well-drained uplands. The main soils that developed in ground-moraine tills are the Egan, Viborg, Wentworth, Whitewood, and Worthing.

The outer margins of the moraines are characterized by moderately rolling hills and many undrained depressions. The materials are mainly clay and silt, but there is some gravel and gravelly outwash. Areas of stones and boulders are common. Soils that developed in the end-moraine tills in Lake County are generally both silty and loamy. They commonly have weak to moderate, prismatic structure. The main soils on the outer margins of the moraines are the Beadle, Egan, Ethan, Viborg, and Worthing.

Chalk of the Niobrara Formation is near the surface in the southwestern corner of the county. This is probably the reason why the area has high-lime soils, such as the Betts and Ethan, which formed in till of Middle Wisconsin age.

Glacial outwash materials are the second most predominant materials in Lake County. The outwash is probably of Middle and Late Wisconsin age. It consists of poorly sorted, stratified sand and gravel that are in places overlain by more silty material of varying thickness. Soils that formed in the outwash are generally medium textured to moderately fine textured. These silty soils have weak to moderate, prismatic and blocky structure. The main soils that formed in outwash in Lake County are the Delmont, Dempster, Enet, and Talmo.

Loess is a minor parent material in Lake County. The loess consists of clayey silt with some fine to very fine sand. Crofton, Moody, Nora, and Trent are the main soils that formed in loess.

Alluvium of Recent age is in the stream valleys. The surface alluvium is a clayey silt that contains some sand and is underlain at varying depths by sand and gravel. Soils that formed in alluvium commonly have a weakly developed, calcareous profile and are somewhat poorly drained to very poorly drained. The Lamo, Rauville, and Volga series are typical of such soils.

Topography

The topography, or the position of the soil on the landscape, affects the soil by influencing its drainage, erosion, plant cover, and soil temperature. The slopes in Lake County range from less than 1 percent on river bottoms to as much as 40 percent on the breaks of the East Fork of the Vermillion River.

Steep soils, such as those of the Betts series, have a calcareous, thin surface layer. More gently sloping soils, such as those of the Houdek series, have a thicker surface layer. These soils formed in similar materials. Excessive runoff from the steep slopes and the higher rate of erosion have retarded the formation of the Betts soils. Soils such as the Prosper, which occur in positions that receive additional moisture, have a thicker and darker colored profile and generally are leached of lime. Soils such as the Lamo and Rauville, which are affected by a fluctuating water table, have a very dark colored surface layer. They are high in content of organic matter but in places are limy or contain soluble salts that are brought upward in the soil solution and are precipitated in the upper layers when the soil dries out.

Time

A long time is required for the formation of soils with distinct horizons. The difference in the length of time that parent materials have been in place, therefore, is commonly reflected in the degree of development of the soil profile.

The soils in Lake County range from young to old. The young soils have very little profile development and the older soils have well-expressed soil horizons. Soils, such as the Lamo, that formed in alluvium on low bottom lands are subject to varying degrees of overflow and receive new sediments with each flooding. These soils have a darkened surface layer but have not had the time for the development of soil structure. The Betts soils are considered young soils because they lack well-developed soil horizons, even though they formed in materials of comparable age to those in which the Houdek and Beadle soils, which have well-developed soil horizons, formed.

Formation of Soil Horizons

Several processes are involved in the formation of soil horizons in the soils of Lake County. These include the accumulation of organic matter, the leaching or accumulation of soluble salts and lime as carbonates, the formation and translocation of clay minerals, and the reduction and transfer of iron. These processes are continually taking place, generally at the same time throughout the profile. These processes are very slow and take hundreds of thousands of years to reach equilibrium with the environment.

The accumulation of organic matter takes place with the decomposition of plant residue. This process darkens the surface layer and helps to form the A1 horizon. Organic matter, once it has been lost, takes a long time to replace. The soils of Lake County have moderate to high organic-matter content.

It is believed that in order for soils to have distinct soil horizons, lime and soluble salts must be leached before the translocation of clay minerals. Many factors affect this leaching, such as the kinds of salts originally present, the depth to which the soil solution percolates, and the texture of the soil profile. Some soils are continually being recharged of salts and lime by the movement of water upward from underground sources. Because this retards the leaching process, the formation of illuviated clay horizons is slow. The leaching and recharging of lime and soluble salts have resulted in a wide variety of soils in Lake County.

The most important process of soil horizon formation in Lake County is the formation and translocation of silicate clay minerals. The amount of clay minerals in a soil profile depends on the parent materials, but the content of clay varies from one soil horizon to another. Clay minerals are generally eluviated from the A horizon and illuviated in the B horizon of such soils as the Beadle in the form of clay films on the ped faces and in the pores and root channels. In such soils as the Tetonka, an A2 horizon has been formed by considerable eluviation of clay minerals to the B horizon. These horizons are gray colored and have platy structure. The Beadle series is an example of soils that have been subject to clay mineral translocation.

The reduction and transfer of iron are associated mainly with the wetter, more poorly drained soils. This process is called gleying. Moderately well drained to somewhat poorly drained soils have yellowish-brown and reddish-brown mottles, indicating the segregation of iron. Poorly drained to very poorly drained soils have a subsoil and underlying material that are grayish in color, indicating reduction and transfer of iron. Lamo and Rauville soils are some of the soils that have a profile that indicates reduction and transfer of iron.

Classification of the Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation.

Thus, in classification, soils are placed in narrow categories that are used in detailed soil surveys so that knowledge about the soils can be organized and used in managing farms, fields, and woodland; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

The system currently used was adopted by the National Cooperative Soil Survey in 1965 (*6*). This system is under continual study. Therefore, readers interested in the development of the current system should refer to the latest literature available (*4*). In table 7, the soil series of Lake County are placed in some categories of the current system.

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that soils of similar genesis, or mode of origin, are grouped together. The classes of the current system are briefly defined in the following paragraphs.

ORDER: Ten soils orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate these soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different kinds of climate. Table 7 shows that the two soil orders in Lake County are Entisols and Mollisols.

Entisols are light-colored soils that do not have natural genetic horizons or that have only very weakly expressed beginnings of such horizons. These soils do not have traits that reflect soil mixing caused by shrinking and swelling.

Mollisols have formed under grass and have a thick surface horizon darkened by organic matter. The soil material in these soils has not been mixed by shrinking and swelling.

SUBORDER: Each order has been subdivided into suborders, primarily on the basis of the characteristics that seem to produce classes that have the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence of waterlogging or soil differences resulting from the climate or vegetation.

GREAT GROUP: Suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus has accumulated or those that contain a pan that interferes with the growth of roots or movement of water. The features used are the self-mulching properties of clays, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown separately in table 7, because it is the last word in the name of the subgroup.

SUBGROUP: Great groups are subdivided into subgroups, one that represents the central (typic) segment of the group and others, called intergrades, that have properties of the group and also have one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group.

FAMILY: Families are separated within a subgroup primarily on the basis of properties important to the growth of plants or behavior of soils when used for

TABLE 7.—*Classification of soil series*

Series	Family	Subgroup	Order
Badus	Fine-silty, mixed (calcareous), mesic	Cumulic Haplaquolls	Mollisols.
Baltic	Fine, montmorillonitic (calcareous), mesic	Cumulic Haplaquolls	Mollisols.
Beadle	Fine, montmorillonitic, mesic	Typic Argiustolls	Mollisols.
Betts	Fine-loamy, mixed (calcareous), mesic	Typic Ustorthents	Entisols.
Clarno	Fine-loamy, mixed, mesic	Typic Haplustolls	Mollisols.
Crofton	Fine-silty, mixed (calcareous), mesic	Typic Ustorthents	Entisols.
Davis	Fine-loamy, mixed, mesic	Pachic Haplustolls	Mollisols.
Delmont	Fine-loamy over sandy or sandy-skeletal, mixed, mesic.	Udic Haplustolls	Mollisols.
Dempster	Fine-silty over sandy or sandy-skeletal, mixed, mesic.	Udic Haplustolls	Mollisols.
Egan	Fine-silty, mixed, mesic	Udic Haplustolls	Mollisols.
Enet	Fine-loamy over sandy or sandy-skeletal, mixed, mesic.	Pachic Haplustolls	Mollisols.
Ethan	Fine-loamy, mixed, mesic	Entic Haplustolls	Mollisols.
Graceville	Fine-silty, mixed, mesic	Pachic Haplustolls	Mollisols.
Henkin	Coarse-loamy, mixed, mesic	Udic Haplustolls	Mollisols.
Houdek	Fine-loamy, mixed, mesic	Typic Argiustolls	Mollisols.
Lamo	Fine-silty, mixed (calcareous), mesic	Cumulic Haplaquolls	Mollisols.
Moody	Fine-silty, mixed, mesic	Udic Haplustolls	Mollisols.
Nora	Fine-silty, mixed, mesic	Udic Haplustolls	Mollisols.
Prosper	Fine-loamy, mixed, mesic	Pachic Argiustolls	Mollisols.
Rauville	Fine-silty, mixed (calcareous), frigid	Cumulic Haplaquolls	Mollisols.
Sinai	Fine, montmorillonitic	Pachic Udic Haploborolls	Mollisols.
Stickney	Fine, mixed, mesic	Glossic Natrustolls	Mollisols.
Talmo	Sandy-skeletal, mixed, mesic	Udorthentic Haplustolls	Mollisols.
Tetonka	Fine, montmorillonitic, mesic	Argiaquic Argialbolls	Mollisols.
Trent	Fine-silty, mixed, mesic	Pachic Haplustolls	Mollisols.
Viborg	Fine-silty, mixed, mesic	Pachic Haplustolls	Mollisols.
Volga	Fine-loamy over sandy or sandy-skeletal, mixed (calcareous), frigid.	Cumulic Haplaquolls	Mollisols.
Wentworth	Fine-silty, mixed, mesic	Udic Haplustolls	Mollisols.
Whitewood	Fine-silty, mixed, mesic	Cumulic Haplaquolls	Mollisols.
Worthing	Fine, montmorillonitic, mesic	Typic Argiaquolls	Mollisols.

engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

SERIES: The series consists of a group of soils that formed from a particular kind of parent material and have genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, structure, reaction, consistence, and mineralogical and chemical composition.

General Nature of the County

Lake County was created in 1873 by an act of the Dakota Territory Legislature. Other than some temporary changes, the present boundaries are the same as when the county was originally constituted. Madison is the county seat of Lake County and the largest town. Other towns in the county are Chester, Franklin, Junius, Nunda, Orland, Ramona, Rutland, Wentworth, and Winfred.

U.S. Highway 81 and State Highways 19 and 34 are the main highways, and they intersect at Madison. Hard-surfaced and gravelled secondary roads connect rural areas and feed into the main highways, so that all parts of the county have easy access to shopping centers.

Two railroads serve the towns of Chester, Junius, Madison, Nunda, Ramona, Rutland, Wentworth, and Winfred.

Industry is mainly that of servicing farms and processing farm products. A small meatpacking plant, a milk processing plant, and a poultry processing plant are in the county. There are also feed and seed mills, a creamery, and grain elevators. Dakota State College, a radio station, and a daily newspaper are in Madison.

Several lakes in the county provide recreation and attract fishermen and waterfowl hunters. Camping facilities at Lake Herman State Park are excellent.

Climate [9]

The climate of Lake County is continental and is largely determined by the movement and interaction of large-scale weather systems. Winters are usually cold, and summers are warm to hot. Precipitation ranges from marginal to adequate for crops.

No large bodies of water or other topographical features affect the climate, but a number of small lakes in the county may have an effect on the climate in their immediate vicinity. The largest of these, Lake Madison, located about 2 miles southeast of Madison, is about 5 miles long and 1 mile wide.

The climatic summaries in tables 8 and 9 are based on 70 years of weather records made at Wentworth, located near the east-central part of the county. The an-

[9] By WALTER SPUHLER, climatologist for South Dakota, National Weather Service, U.S. Department of Commerce.

nual precipitation over the county is expected to be within about 1 inch of that at Wentworth. The average annual temperature over the county is expected to be within 1 degree of that at Wentworth.

Temperatures have a large variation annually and occasionally from day to day. The temperature usually rises to 100° F. or higher during the summer and drops to 20° below zero or colder during the winter. On the average, temperatures are expected to climb to 100° or more about once a year in July and about twice in 3 years during the rest of the summer. The temperature drops to 30° below zero or lower about once in 2 years. It drops to 20° below zero or lower about twice a year in January, once a year in February, and once in 2 years in March. Minimum temperatures of zero or lower can be expected about 32 times per year. The temperature may fail to climb above zero during the day about 3 times per year.

TABLE 8.—*Temperature and precipitation*

[Data recorded at Wentworth; period of record, 1896 to 1965]

Month	Temperature				Precipitation							
			2 years in 10 will have—					1 year in 10 will have—			Average number of days with—	
	Average daily maximum	Average daily minimum	Average maximum temperature equal to or higher than—	Average minimum temperature equal to or lower than—	Average total	Maximum total	Minimum total	Less than—	More than—	Average total snowfall	Snowfall of 1 inch or more	Depth of snow cover of 1 inch or more
	°F.	°F.	°F.	°F.	Inches	Inches	Inches	Inches	Inches	Inches		
January	24. 3	3. 1	33. 0	−5. 4	0. 55	3. 03	0	0. 09	1. 18	5. 3	2	13
February	28. 1	6. 6	36. 2	−2. 3	. 58	1. 84	0	. 13	1. 45	5. 9	2	12
March	40. 2	19. 0	48. 8	12. 1	1. 16	3. 84	. 03	. 24	2. 73	6. 9	2	6
April	57. 6	32. 7	64. 2	28. 1	2. 20	6. 08	. 07	1. 59	4. 40	2. 0	0	0
May	69. 7	44. 3	75. 7	39. 5	3. 38	11. 86	. 44	1. 21	5. 92	. 1	0	0
June	78. 3	54. 1	83. 6	50. 3	4. 24	10. 96	1. 00	1. 90	7. 05	0	0	0
July	84. 6	59. 1	89. 6	55. 6	3. 19	8. 58	. 08	. 79	6. 32	0	0	0
August	83. 0	57. 1	87. 2	53. 5	3. 08	8. 48	. 06	1. 12	5. 45	0	0	0
September	73. 6	47. 7	79. 7	43. 1	2. 55	5. 95	. 19	. 90	4. 65	0	0	0
October	61. 9	36. 3	69. 5	30. 5	1. 50	6. 48	0	. 33	3. 91	. 7	0	0
November	42. 8	21. 4	51. 0	14. 7	. 85	3. 48	0	. 09	1. 82	2. 8	1	3
December	28. 8	9. 1	37. 2	. 3	. 53	2. 19	0	. 13	1. 12	4. 4	1	10
Year	56. 1	32. 5	58. 6	30. 4	23. 81	[1] 36. 89	[2] 13. 69	17. 54	30. 23	28. 1	8	44

[1] In 1914.
[2] In 1933.

TABLE 9.—*Probabilities of specified temperatures after specified dates in spring and before specified dates in fall* [1]

[Data recorded at Wentworth; period of record, 1896 to 1965]

Probability	Dates for given probability and temperature					
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower	36° F. or lower
After specified dates in spring:						
90 percent	March 12	March 22	March 29	April 10	April 23	May 4
70 percent	March 19	March 29	April 5	April 18	April 30	May 11
50 percent	April 1	April 12	April 19	May 4	May 14	May 25
30 percent	April 13	April 24	May 2	May 18	May 27	June 7
10 percent	April 20	May 1	May 10	May 26	June 3	June 15
Before specified dates in fall:						
10 percent	October 15	October 6	September 26	September 15	September 8	August 30
30 percent	October 22	October 13	October 3	September 22	September 14	September 6
50 percent	November 4	October 27	October 18	October 6	September 28	September 19
70 percent	November 17	November 10	November 1	October 19	October 10	October 1
90 percent	November 24	November 17	November 9	October 26	October 17	October 8

[1] Prepared by WILLIAM F. LYTLE, South Dakota State University.

The chance of certain low temperatures occurring after specified dates in spring or before specified dates in the fall is given in table 9. For example, the upper half of the table shows a 50-percent chance that a temperature of 32° will occur on or after May 14. Similarly, the lower half of table 9 shows that there is a 70-percent chance that a temperature of 32° or lower will occur by October 10. This should be interpreted to mean that, on the average, in 7 years out of 10 the temperature will be 32° or lower at Wentworth on or before this date. These figures refer to air temperatures as measured in a standard instrument shelter. Soil and plant temperatures vary somewhat from the temperature of the free air.

The average annual precipitation at Wentworth is 23.81 inches, of which 18.64 inches, or 78 percent, falls during the growing season (April-September). During the 70-year period from 1896 to 1965, the annual precipitation ranged from 13.69 inches in 1933 to 36.89 inches in 1914. Thundershowers are the main source of rainfall during the growing season and occur in a wide range of intensities and amounts. Rainfall of 1 inch or more in 1 hour may be expected about once a year. Two inches or more of rainfall in 1 hour may be expected about once in 6 years. Rainfall of 2 inches or more in a 24-hour period may be expected about 5 times in 7 years, and about once in 8 years a rainfall of 3 inches or more in a 24-hour period may be expected.

A snow cover is important for the protection of pasture and fall-seeded grains in winter, but it may be a hindrance to farm or ranch activities. The seasonal snowfall at Wentworth averages 28 inches and has ranged from 6 inches during the 1930-31 season to 62 inches during the 1961-62 season.

Data on sunshine, wind, and relative humidity are not recorded at Wentworth. However, data from Sioux Falls and Huron can be used to estimate conditions in Lake County. The sun shines on the average about 63 percent of the total possible time during the year. The relative humidity in Lake County usually has a large variation from early morning to afternoon and, occasionally, from day to day. The annual average relative humidity is about 81 percent early in the morning and about 60 percent during the afternoon. Windspeed averages 11 to 12 miles per hour, and the prevailing winds are generally from the south in summer and from the northwest in winter. A windspeed of 50 miles per hour or more may occur during any month but is most likely to occur in summer in association with thunderstorms.

Thunderstorms occur on the average about 7 days per month in May, 9 in June and in July, 8 in August, and 5 in September; fewer thunderstorms occur in other months. The annual average is about 44. Hail occasionally accompanies the thunderstorms and may be expected at any one location in the county about once a year. Hail has been reported as early as February and as late as September, but the month of most frequent occurrence is June.

In this county the average annual pan evaporation is about 49 inches. An average of about 39 inches evaporates from May through October. The annual evaporation from small lakes is about 35 inches, and the water loss from soil and crops is usually less, depending upon the available soil moisture.

Farming

According to the 1964 Census of Agriculture, land in farms totaled 344,030 acres, or about 94 percent of the county. There were 1,049 farms with an average size of 328 acres. In 1930, however, there were 1,352 farms with an average size of 256 acres. Most of the decrease in the number of farms and the increase in average size has occurred since 1950.

The principal crops are corn and oats. In 1964 there was 112,930 acres of corn, 57,773 acres of oats, 20,870 acres in alfalfa, 10,096 acres of soybeans, and 8,779 acres of flax. The acreages of corn, oats, and flax since 1930 have been relatively stable except for slight fluctuations. Acreage in alfalfa is increasing. Soybeans did not become a common crop until about 1950.

About 75 percent of the farm income in the county is derived from the sale of livestock and livestock products. Cattle and sheep have been on the increase since 1930, while the number of hogs has declined. In 1964 there were 55,025 cattle, 52,097 hogs, and 33,928 sheep on farms. Chickens numbered 267,620.

Literature Cited

(1) American Association of State Highway Officials.
1961. standard specifications for highway materials and methods of sampling and testing. Ed. 8, 2 v., 401 and 617 pp., illus. Washington, D.C.

(2) Clayton, L., and Treers, T.
1967. glacial geology of the missouri coteau and adjacent areas. North Dakota Geological Survey, Miscellaneous Series 30, 170 pp., illus.

(3) Flint, Richard Foster.
1955. pleistocene geology of eastern south dakota. U.S. Geological Survey, Professional Paper 262, 173 pp., illus.

(4) Simonson, Roy W.
1962. soil classification in the united states. Sci. 137: 1027-1034, illus.

(5) united states department of agriculture.
1951. soil survey manual. Agr. Handbook No. 18, 503 pp., illus. [Supplement issued in May 1962]

(6) ———
1960. soil classification, a comprehensive system, 7th approximation. 265 pp., illus. [Supplements issued in March 1967 and September 1968.]

(7) ———
1961. land-capability classification. Agr. Handbook No. 210, 21 pp.

(8) United States Department of Defense.
1968. unified soil classification system for roads, airfields, embankments and foundations. MIL-STD-619B, 30 pp., illus.

Glossary

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed 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 capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Bottom land. Land bordering a stream, built up of sediments from overflow of the stream and subject to inundation when the stream is at flood stage.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold dilute hydrochloric acid.

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.

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 and brittle; little affected by moistening.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, 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 different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Glacial drift. Rock material transported by glacial ice and then deposited; also includes the assorted and unassorted materials deposited by streams flowing from glaciers.

Glacial outwash. Materials moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. Deposits are generally stratified and are composed of sand, gravel, and silts.

Glacial till. Unstratified glacial drift deposited directly by the ice and consisting of clay, sand, gravel, and boulders intermingled in any proportion.

Gravel. Rounded or angular rock fragments that are not prominently flattened and are up to 3 inches in diameter. An individual fragment is called a pebble.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

0 horizon.—The layer of organic matter on the surface of a mineral soil. This layer consist of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an 0 horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Humus. The well-decomposed, more or less stable part of the organic matter in mineral soils.

Leached soil. A soil from which most of the soluble materials have been removed from the entire profile or have been removed from one part of the profile and have accumulated in another part.

Loess. Fine-grained material, dominantly of silt-sized particles, that has been deposited by wind.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of 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 these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Reaction soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Runoff (hydraulics). The part of the precipitation upon a drainage area that is discharged from the area in stream channels. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes 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 other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *pris-*

matic (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. Structureless soils are either *single grain* (each grain by itself, as in dune sand), or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Stubble mulch. The stubble of crops or crop residues left essentially in place on the land as a surface cover before and during preparation of the seedbed and at least partly during the growing of a succeeding crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

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 may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

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